UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,853,690 B1
APPLICATION NO. : 09/525615
DATED : February 8, 2005
INVENTOR(S) : Sorrells et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page should be deleted and substitute therefor the attached title page as shown on the attached title page.

Drawings

Please replace all of the drawings with the attached 144 pages of formal drawings.

Column 5

In line 65, please replace "FIGS. 55A-D illustrates" with --FIGS. 55A-D, which includes FIGs. 55A, FIGs. 55B1-55B4, FIGs. 55C1-55C3, and FIG. 55D, illustrates--.

In line 67, after "invention;", please insert -- FIGs. 55B1-55B4 should be referred to for all references to FIG. 55B in the specification; FIGs. 55C1-55C3 should be referred to for all references to FIG. 55C in the specification; --.

Column 6

In line 45, please replace "FIG. 70A illustrates" with -- FIG. 70A, which includes FIG. 70A1 and FIG. 70A2, illustrates --.

In line 46, after "invention,", please insert -- FIGs. 70A1 and 70A2 should be referred to for all references to FIG. 70 in the specification; --.

In line 52, please replace "FIG. 70E illustrates" with -- FIG. 70E, which includes FIG. 70E1 and 70E2, illustrates --.

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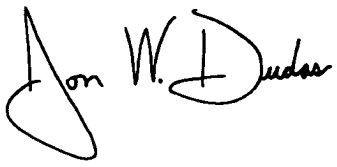
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 6 (continued)
In line 53, after "invention;", please insert -- FIGs. 70E1 and 70E2 should be referred to for all references to FIG. 70 in the specification; --.

Signed and Sealed this

Twenty-second Day of January, 2008



JON W. DUDAS
Director of the United States Patent and Trademark Office

(12) **United States Patent**
Sorrells et al.

(10) **Patent No.: US 6,853,690 B1**
(45) **Date of Patent: Feb. 8, 2005**

(54) **METHOD, SYSTEM AND APPARATUS FOR BALANCED FREQUENCY UP-CONVERSION OF A BASEBAND SIGNAL AND 4-PHASE RECEIVER AND TRANSCEIVER EMBODIMENTS**

(75) Inventors: **David F. Sorrells**, Jacksonville, FL (US); **Michael J. Bultman**, Jacksonville, FL (US); **Robert W. Cook**, Switzerland, FL (US); **Richard C. Looke**, Jacksonville, FL (US); **Charley D. Moses, Jr.**, Jacksonville, FL (US); **Gregory S. Rawlins**, Lake Mary, FL (US); **Michael W. Rawlins**, Lake Mary, FL (US)

(73) Assignee: **ParkerVision, Inc.**, Jacksonville, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/525,615**

(22) Filed: **Mar. 14, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/177,381, filed on Jan. 24, 2000, provisional application No. 60/171,502, filed on Dec. 22, 1999, provisional application No. 60/177,705, filed on Jan. 24, 2000, provisional application No. 60/129,839, filed on Apr. 16, 1999, provisional application No. 60/158,047, filed on Oct. 7, 1999, provisional application No. 60/171,349, filed on Dec. 21, 1999, provisional application No. 60/177,702, filed on Jan. 24, 2000, provisional application No. 60/180,667, filed on Feb. 7, 2000, and provisional application No. 60/171,496, filed on Dec. 22, 1999.

(51) Int. Cl.[7] **H04L 27/04**; H04L 27/12; H04L 27/20

(52) U.S. Cl. **375/295**; 375/298; 375/259; 375/256; 455/76; 455/91

(58) Field of Search 375/295–296, 375/298, 309–312, 256, 259, 268; 455/118, 323, 313, 76, 91

(56) **References Cited**

U.S. PATENT DOCUMENTS

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(List continued on next page.)

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OTHER PUBLICATIONS

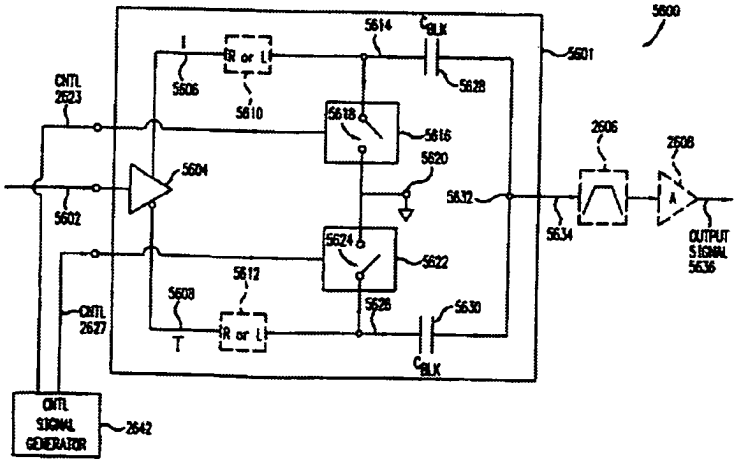
Simoni, A. et al., "A Single-Chip Optical Sensor with Analog Memory for Motion Detection," *IEEE Journal of Solid-State Circuits*, IEEE, vol. 30, No. 7, pp. 800–806 (Jul. 1995).

(List continued on next page.)

Primary Examiner—Phuong Phu
(74) *Attorney, Agent, or Firm*—Sterne, Kessler, Goldstein & Fox PLLC

(57) **ABSTRACT**

A balanced transmitter up-converts a baseband signal directly from baseband-to-RF. The up-conversion process is sufficiently linear that no IF processing is required, even in communications applications that have stringent requirements on spectral growth. In operation, the balanced modulator sub-harmonically samples the baseband signal in a balanced and differential manner, resulting in harmonically rich signal. The harmonically rich signal contains multiple harmonic images that repeat at multiples of the sampling frequency, where each harmonic contains the necessary information to reconstruct the baseband signal. The differential sampling is performed according to a first and second control signals that are phase shifted with respect to each other. In embodiments of the invention, the control signals have pulse widths (or apertures) that operate to improve energy transfer to a desired harmonic in the harmonically rich signal. A bandpass filter can then be utilized to select the desired harmonic of interest from the harmonically rich signal. The sampling modules that perform the sampling can



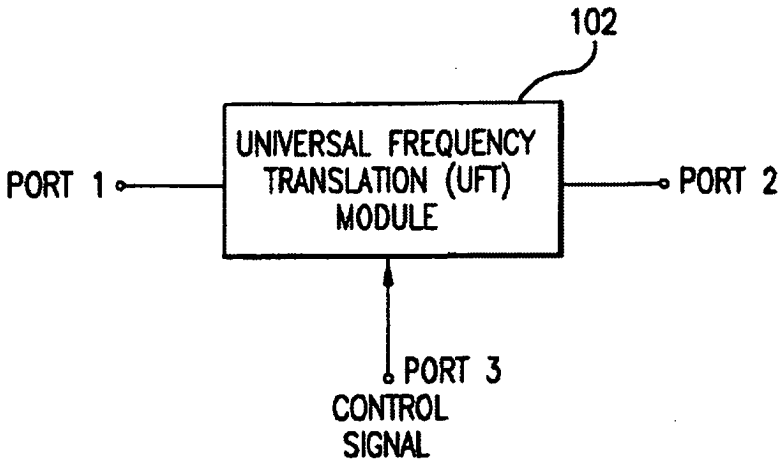

102
UNIVERSAL FREQUENCY TRANSLATION (UFT) MODULE
PORT 1
PORT 2
PORT 3
CONTROL SIGNAL

FIG. 1A

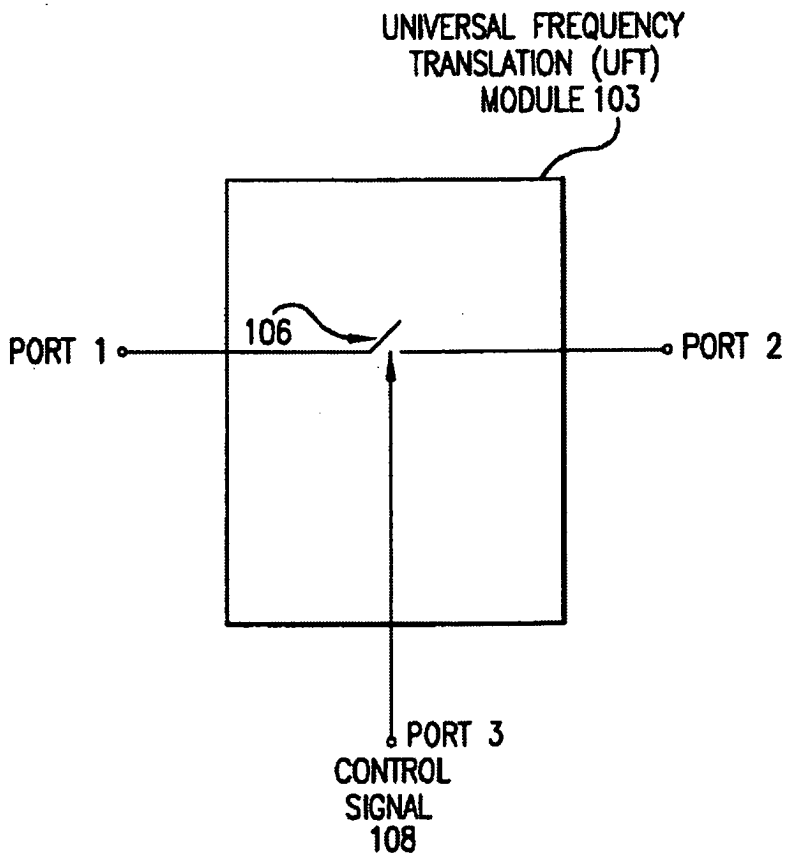

UNIVERSAL FREQUENCY TRANSLATION (UFT) MODULE 103
106
PORT 1
PORT 2
PORT 3
CONTROL SIGNAL 108

FIG. 1B

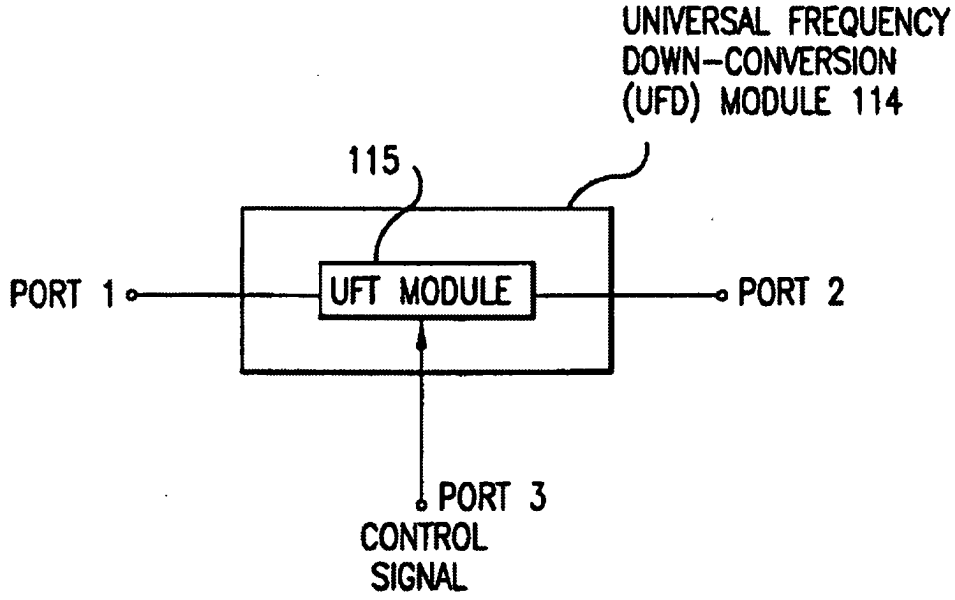

UNIVERSAL FREQUENCY
DOWN-CONVERSION
(UFD) MODULE 114
115
PORT 1
UFT MODULE
PORT 2
PORT 3
CONTROL
SIGNAL

FIG. 1C

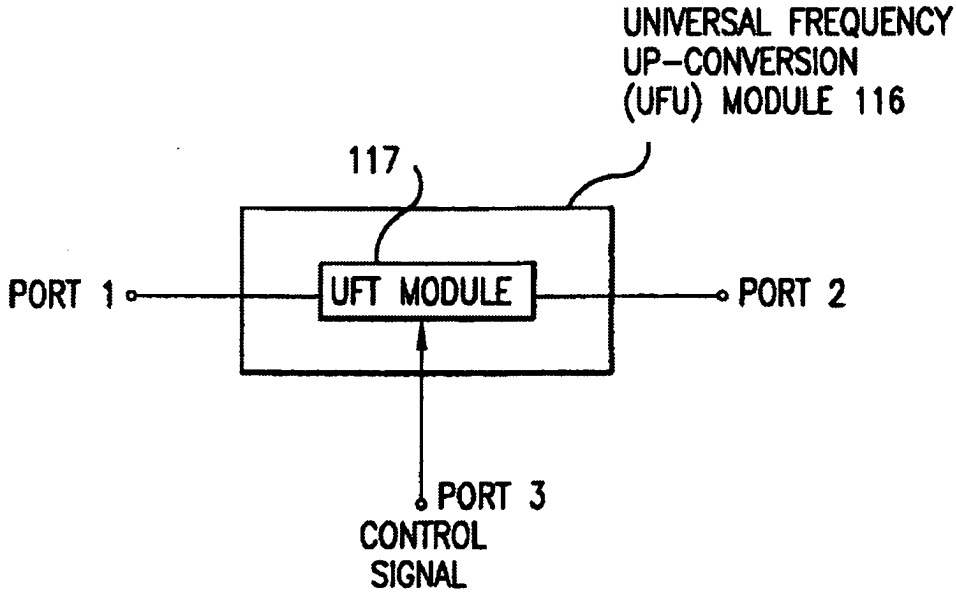

UNIVERSAL FREQUENCY
UP-CONVERSION
(UFU) MODULE 116
117
PORT 1
UFT MODULE
PORT 2
PORT 3
CONTROL
SIGNAL

FIG. 1D

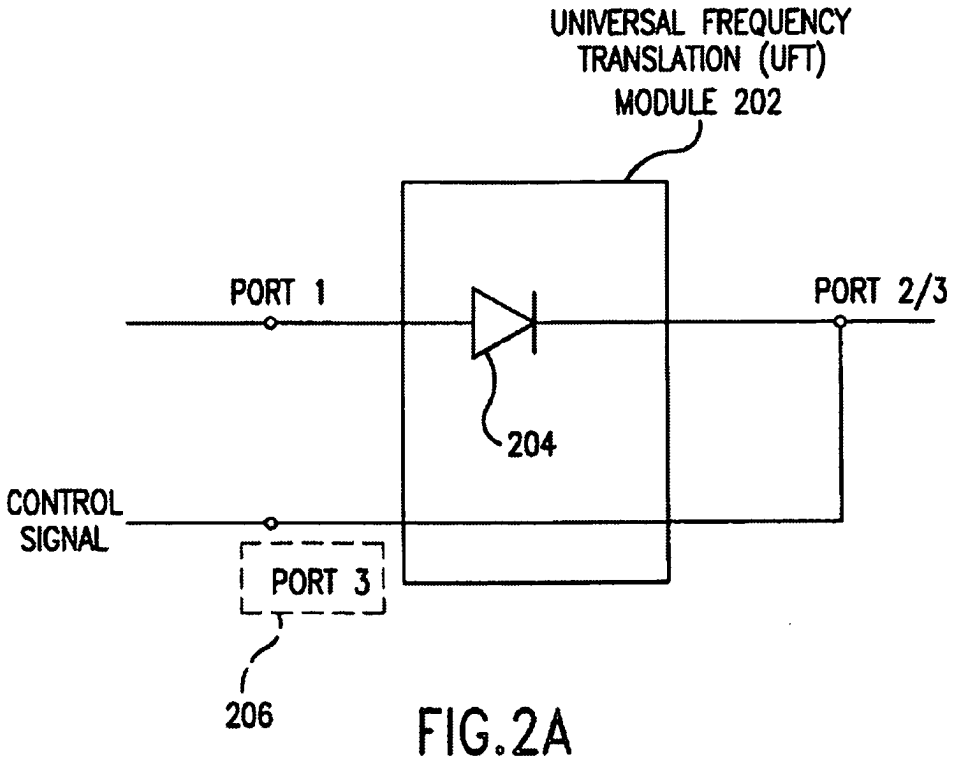

UNIVERSAL FREQUENCY
TRANSLATION (UFT)
MODULE 202
PORT 1
PORT 2/3
204
CONTROL
SIGNAL
PORT 3
206

FIG.2A

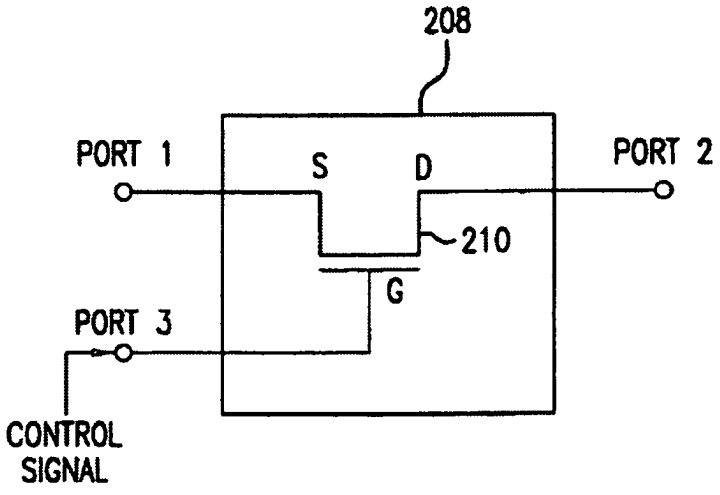

208
PORT 1
S
D
PORT 2
210
G
PORT 3
CONTROL
SIGNAL

FIG.2B

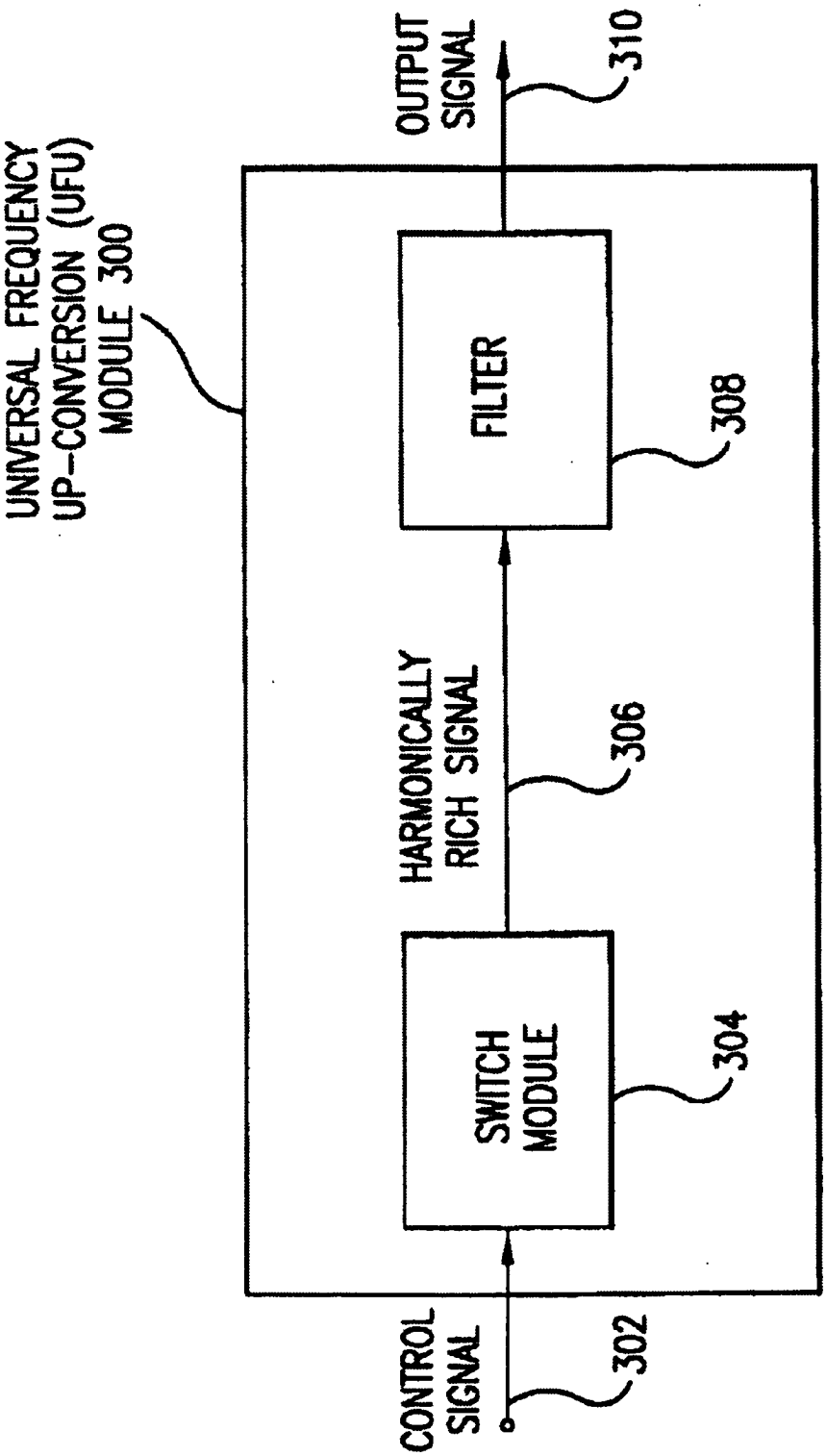

UNIVERSAL FREQUENCY UP-CONVERSION (UFU) MODULE 300
OUTPUT SIGNAL
310
FILTER
308
HARMONICALLY RICH SIGNAL
306
SWITCH MODULE
304
CONTROL SIGNAL
302

FIG. 3

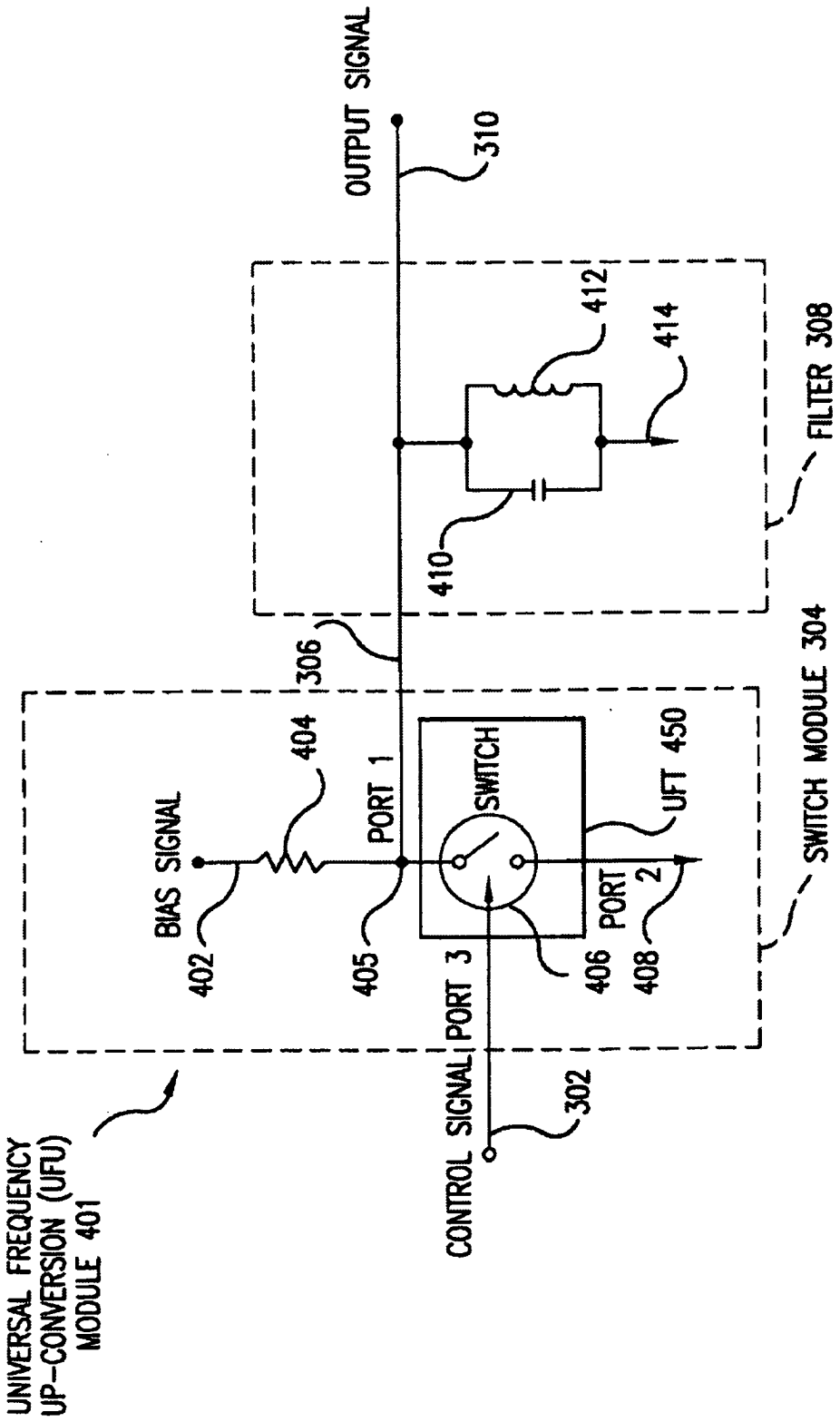

OUTPUT SIGNAL
310
412
414
FILTER 308
410
306
SWITCH MODULE 304
404
BIAS SIGNAL
PORT 1
SWITCH
UFT 450
402
405
406
PORT 2
408
PORT 3
CONTROL SIGNAL
302
UNIVERSAL FREQUENCY UP-CONVERSION (UFU) MODULE 401

FIG. 4

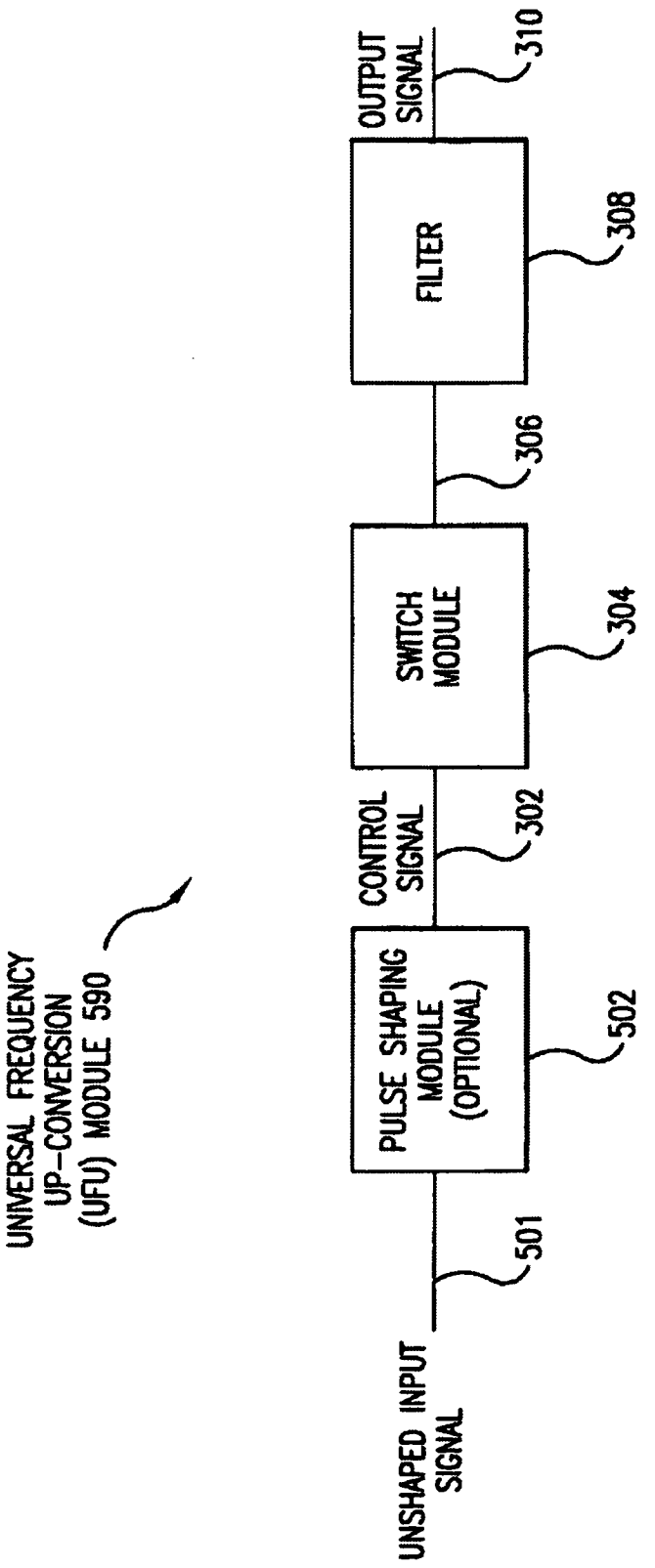

UNIVERSAL FREQUENCY UP-CONVERSION (UFU) MODULE 590
UNSHAPED INPUT SIGNAL
501
PULSE SHAPING MODULE (OPTIONAL)
502
CONTROL SIGNAL
302
SWITCH MODULE
304
306
FILTER
308
OUTPUT SIGNAL
310

FIG. 5

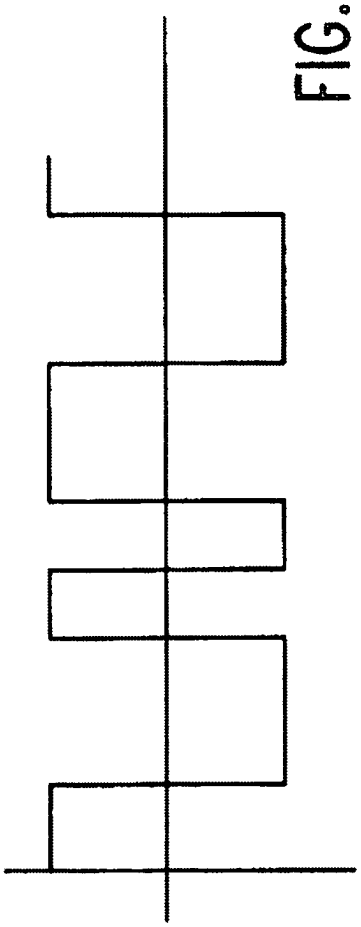


FIG. 6A

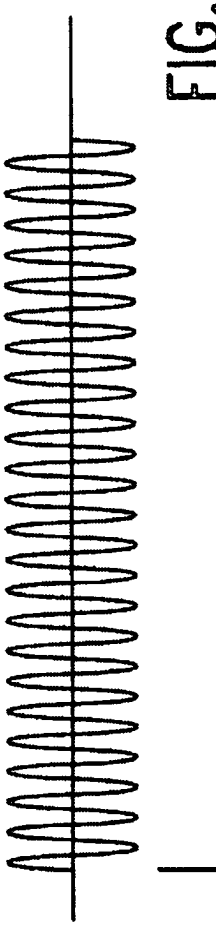


FIG. 6B

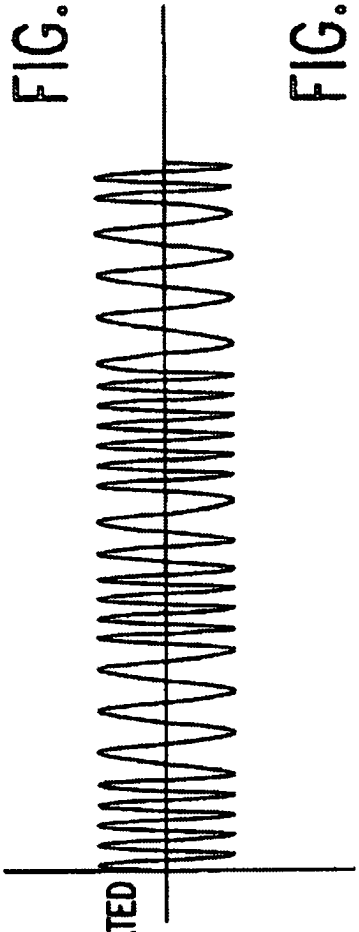


FIG. 6C

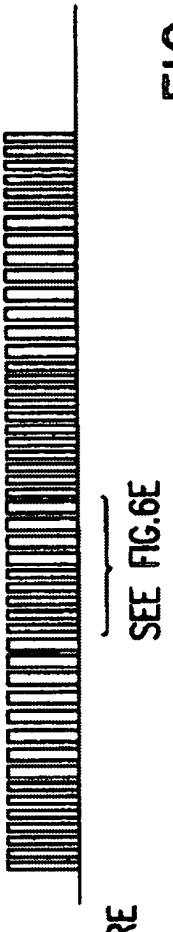


FIG. 6D

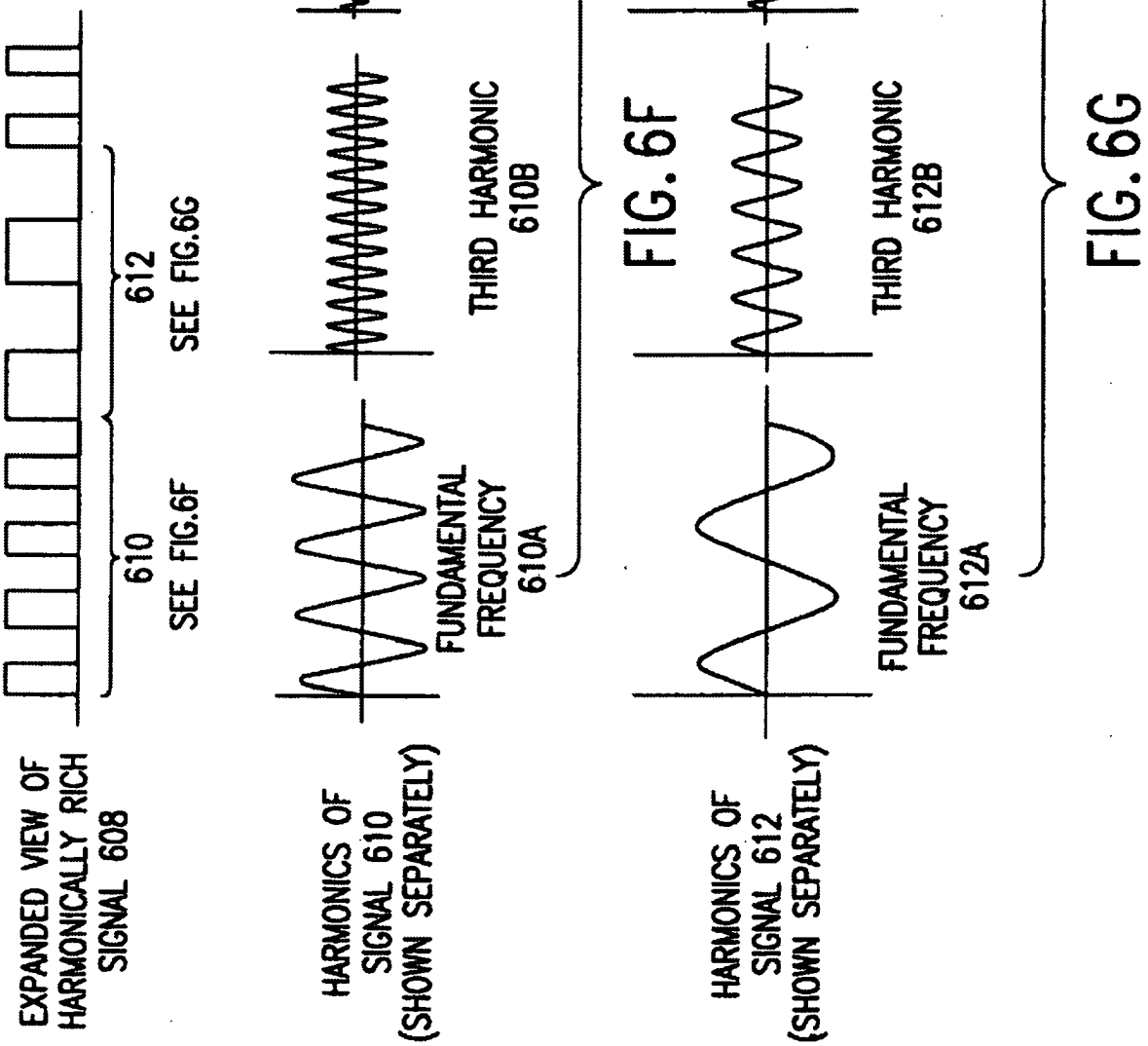


FIG. 6E

FIG. 6F

FIG. 6G

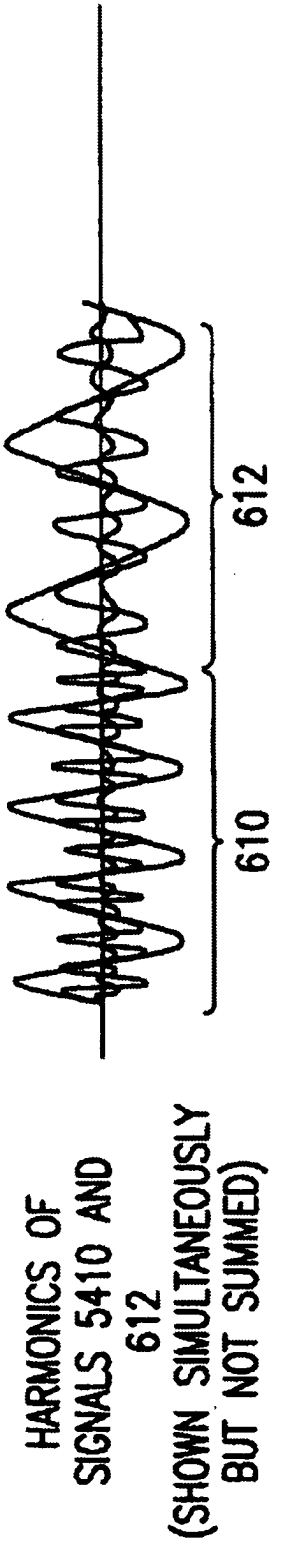

HARMONICS OF
SIGNALS 5410 AND
612
(SHOWN SIMULTANEOUSLY
BUT NOT SUMMED)
610
612

FIG. 6H

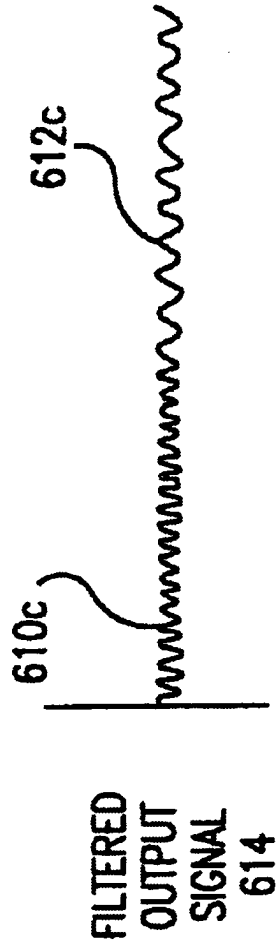

610c
612c
FILTERED
OUTPUT
SIGNAL
614

FIG. 6I

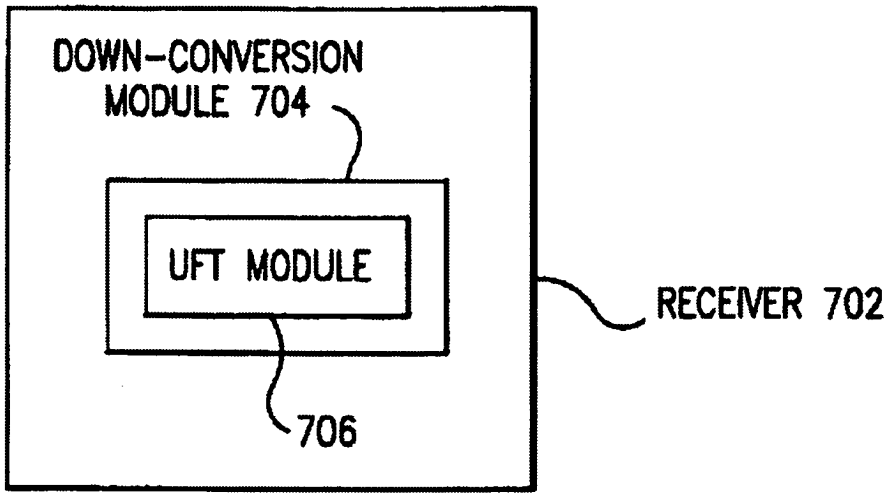

DOWN-CONVERSION MODULE 704
UFT MODULE
706
RECEIVER 702

FIG. 7

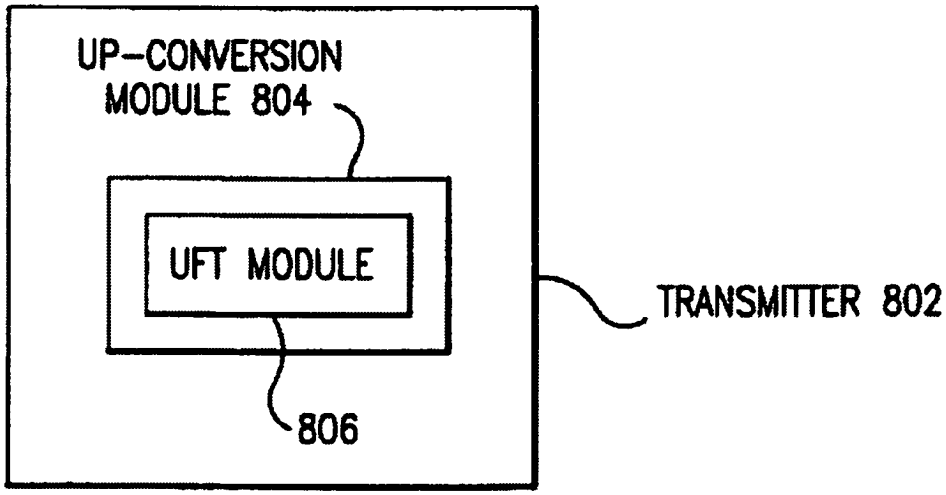

UP-CONVERSION MODULE 804
UFT MODULE
806
TRANSMITTER 802

FIG. 8

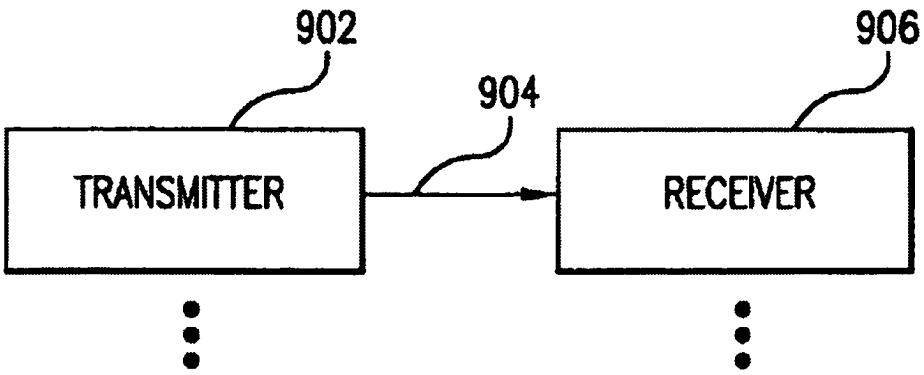

902
904
906
TRANSMITTER
RECEIVER

FIG. 9

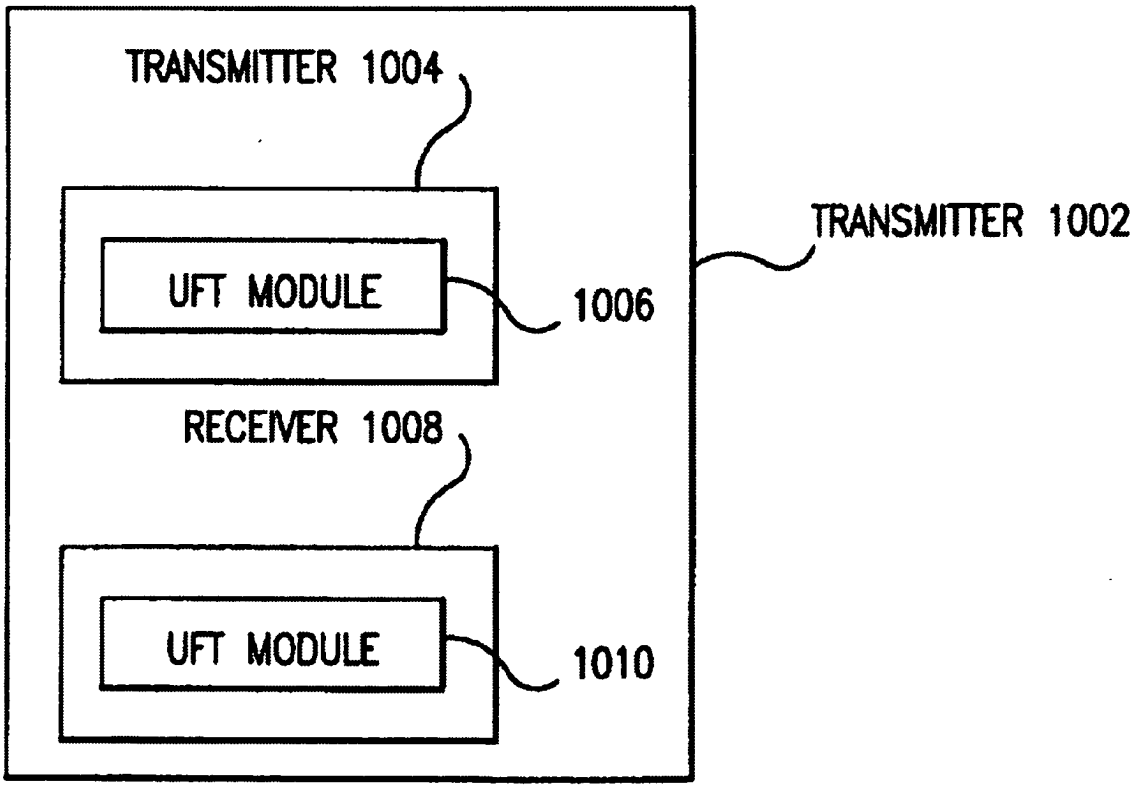

TRANSMITTER 1004
TRANSMITTER 1002
UFT MODULE
1006
RECEIVER 1008
UFT MODULE
1010

FIG. 10

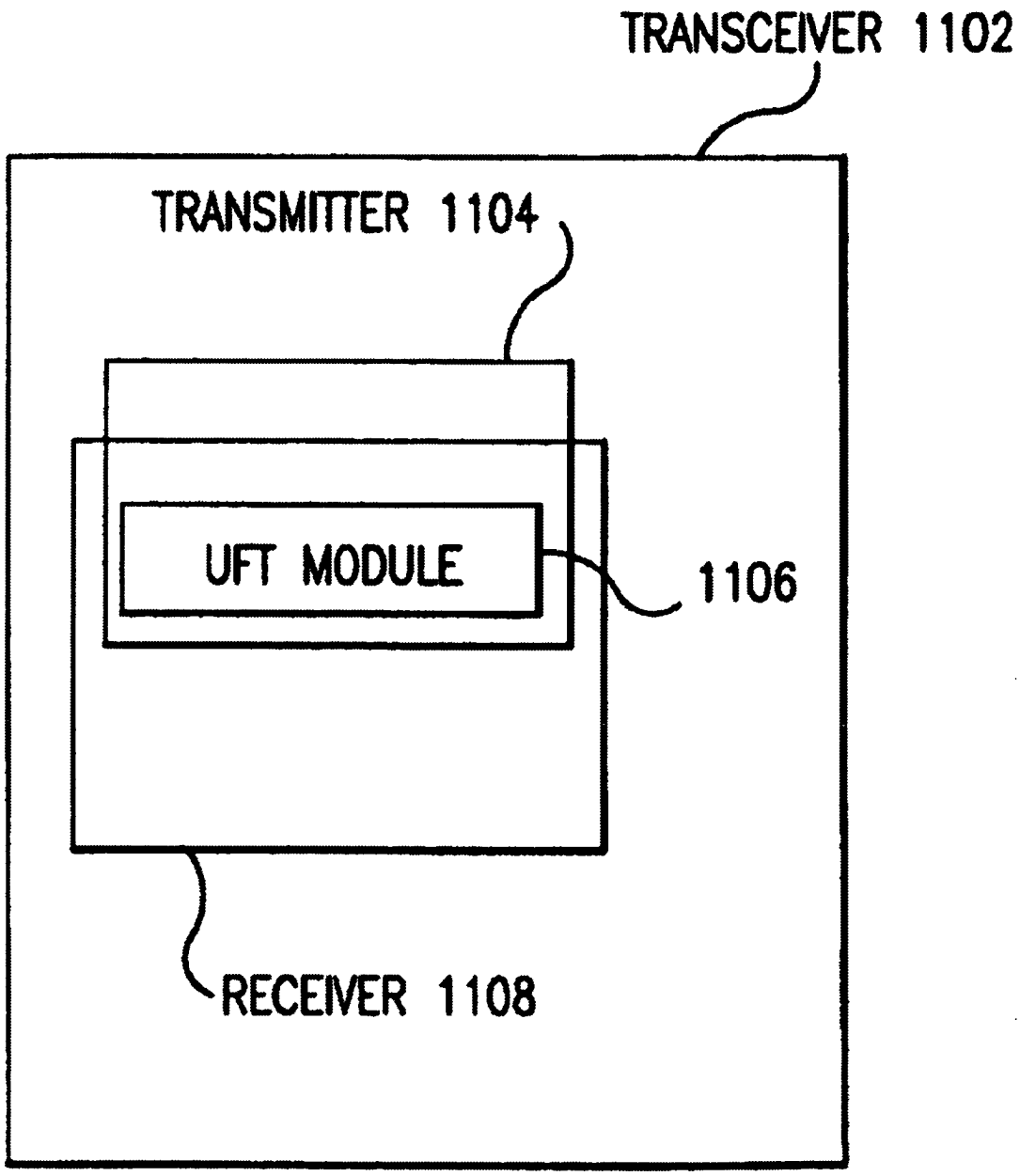

TRANSCEIVER 1102
TRANSMITTER 1104
UFT MODULE
1106
RECEIVER 1108

FIG. 11

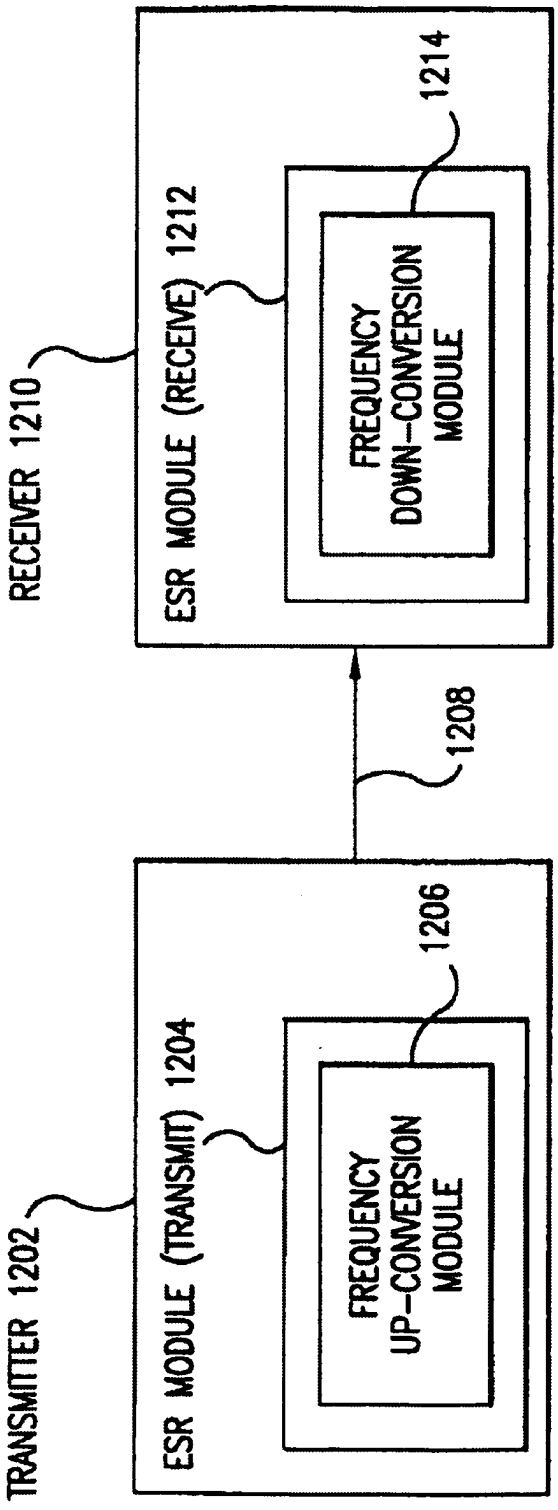

TRANSMITTER 1202
ESR MODULE (TRANSMIT) 1204
FREQUENCY UP-CONVERSION MODULE
1206
1208
RECEIVER 1210
ESR MODULE (RECEIVE) 1212
FREQUENCY DOWN-CONVERSION MODULE
1214

FIG. 12

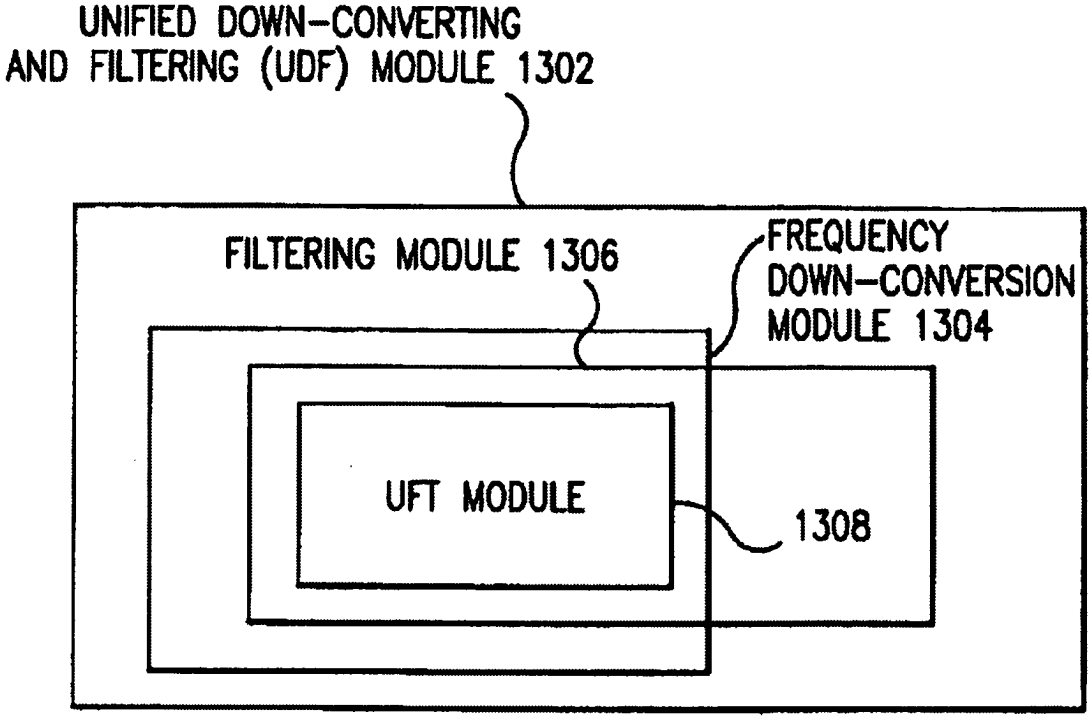

UNIFIED DOWN-CONVERTING
AND FILTERING (UDF) MODULE 1302
FILTERING MODULE 1306
FREQUENCY
DOWN-CONVERSION
MODULE 1304
UFT MODULE
1308

FIG. 13

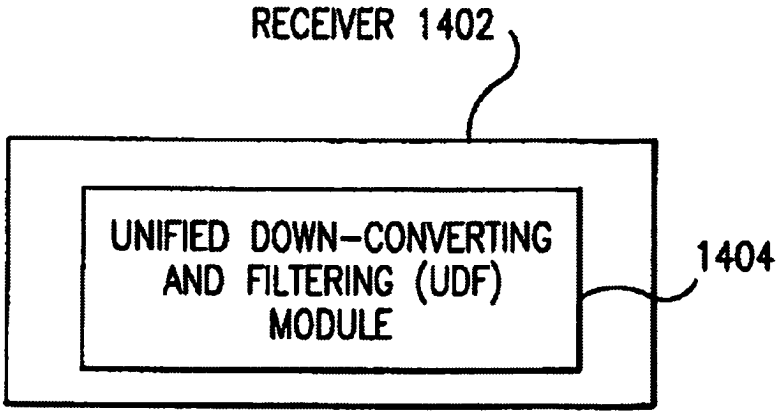

RECEIVER 1402
UNIFIED DOWN-CONVERTING
AND FILTERING (UDF)
MODULE
1404

FIG. 14

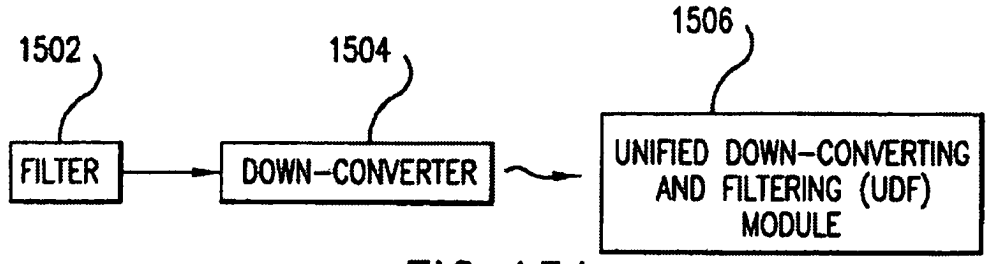


FIG. 15A

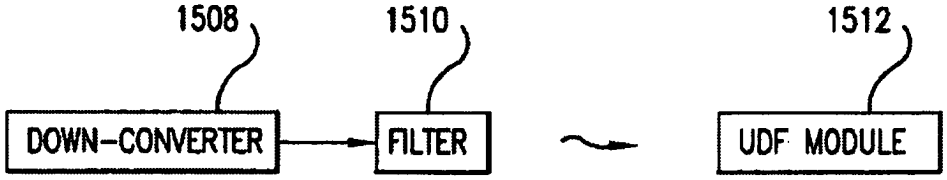


FIG. 15B

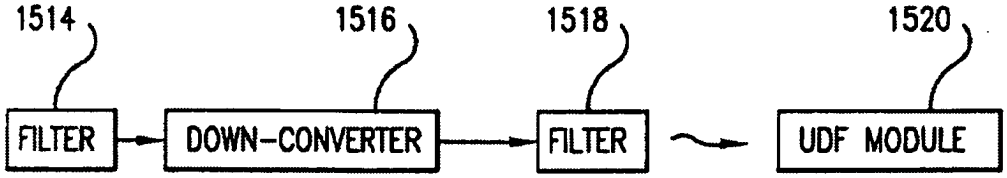


FIG. 15C

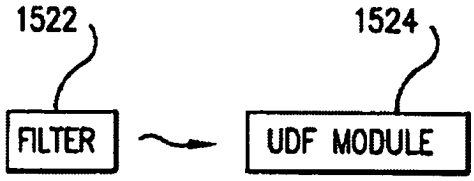


FIG. 15D

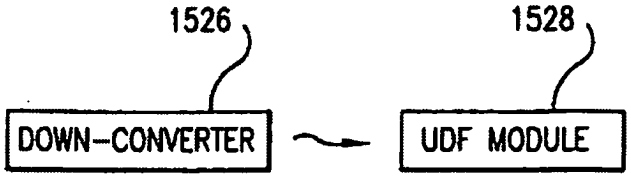


FIG. 15E

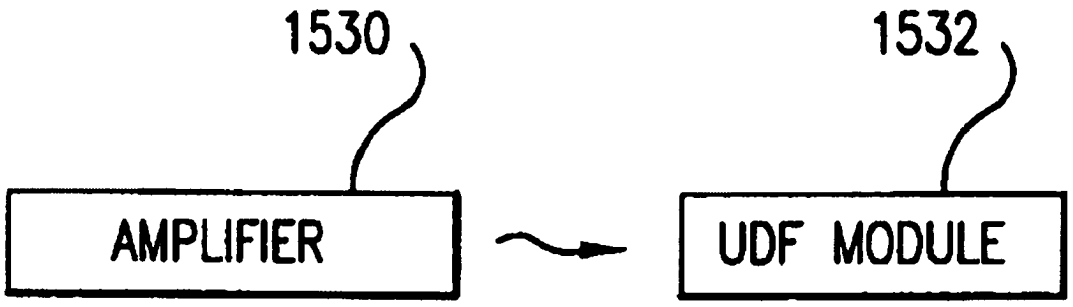


FIG. 15F

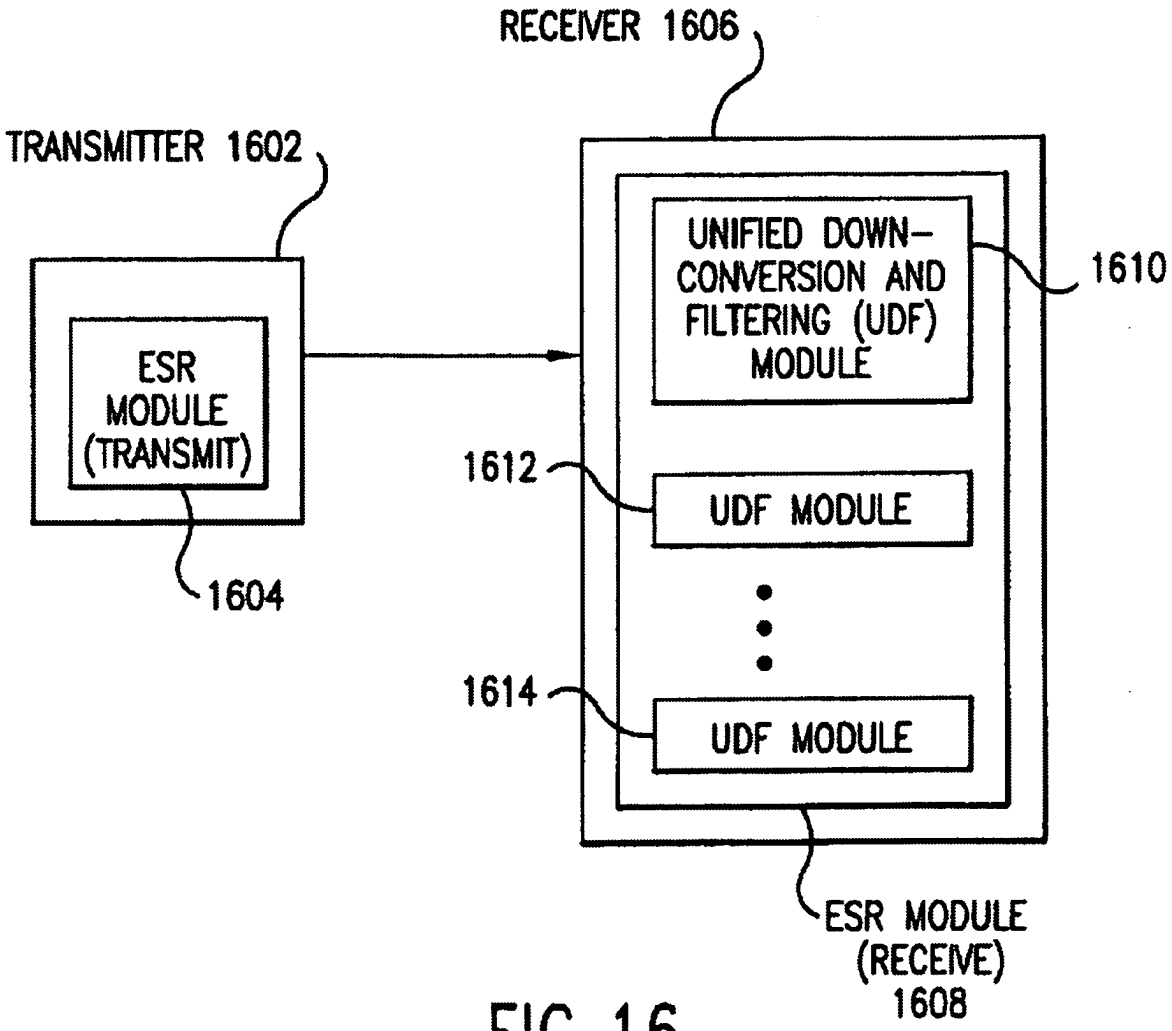

RECEIVER 1606
TRANSMITTER 1602
UNIFIED DOWN-CONVERSION AND FILTERING (UDF) MODULE
1610
ESR MODULE (TRANSMIT)
1612
UDF MODULE
1614
UDF MODULE
1604
ESR MODULE (RECEIVE) 1608

FIG. 16

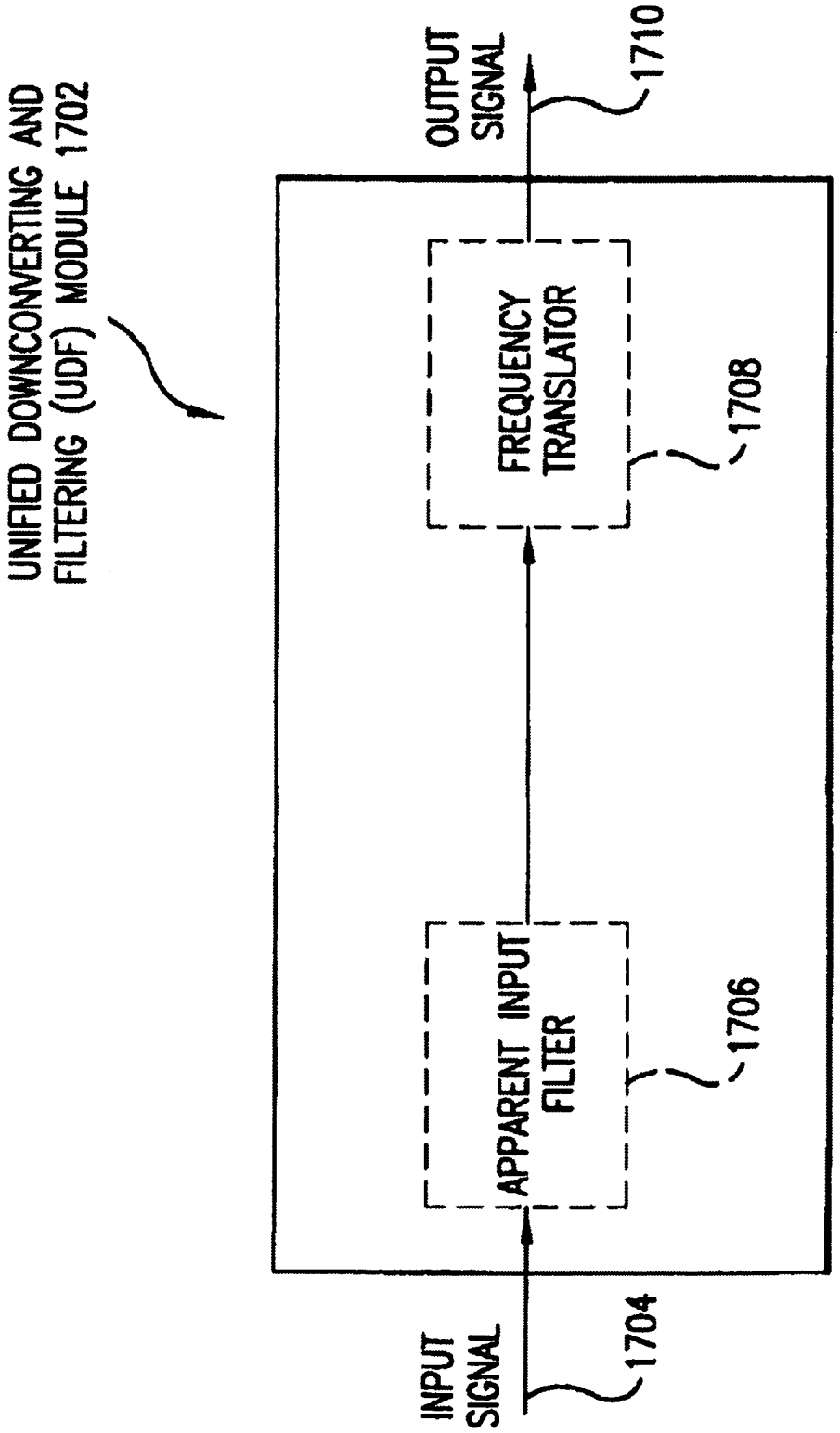

UNIFIED DOWNCONVERTING AND FILTERING (UDF) MODULE 1702
OUTPUT SIGNAL
1710
FREQUENCY TRANSLATOR
1708
APPARENT INPUT FILTER
1706
INPUT SIGNAL
1704

FIG. 17

1802

TIME / NODE	t-1 (RISING EDGE OF Φ_1) 1804	t-1 (RISING EDGE OF Φ_2) 1808	t (RISING EDGE OF Φ_1) 1816	t (RISING EDGE OF Φ_2) 1826	t+1 (RISING EDGE OF Φ_1) 1838
1902	VI_{t-1}	VI_{t-1}	VI_t	VI_t	VI_{t+1}
1904	—	VI_{t-1} 1810	VI_{t-1} 1818	VI_t 1828	VI_t 1840
1906	VO_{t-1} 1806	VO_{t-1} 1812	VO_t 1820	VO_t 1830	VO_{t+1} 1842
1908	—	VO_{t-1} 1814	VO_{t-1} 1822	VO_t 1832	VO_t 1844
1910	— 1807	—	VO_{t-1} 1824	VO_{t-1} 1834	VO_t 1846
1912	—	— 1815	—	VO_{t-1} 1836	VO_{t-1} 1848
1918	—	—	—	—	VI_t — $0.1*VO_t$ — $0.8*VO_{t-1}$ 1850

FIG. 18

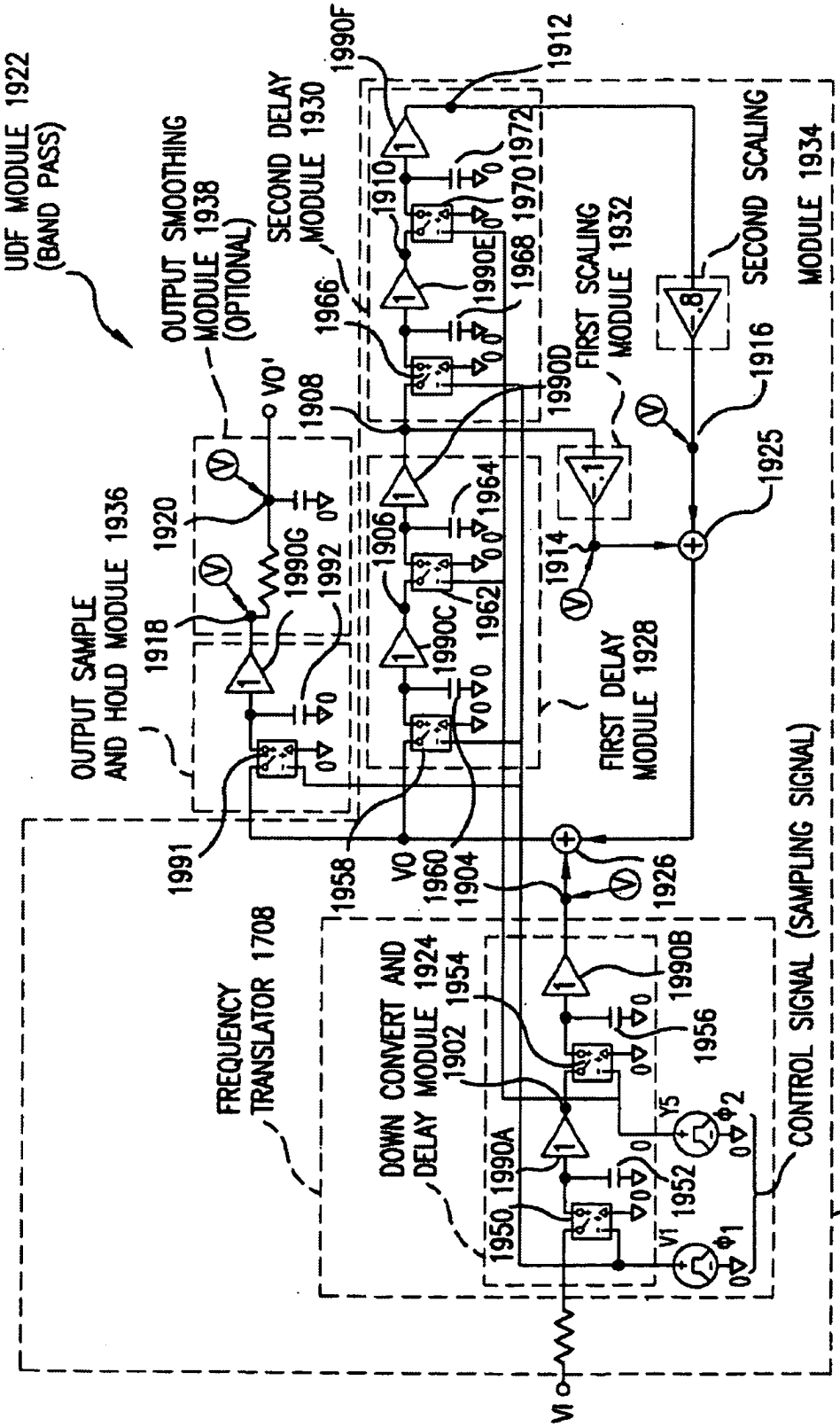

UDF MODULE 1922 (BAND PASS)
OUTPUT SMOOTHING MODULE 1938 (OPTIONAL)
SECOND DELAY MODULE 1930
FIRST SCALING MODULE 1932
SECOND SCALING MODULE 1934
OUTPUT SAMPLE AND HOLD MODULE 1936
FIRST DELAY MODULE 1928
FREQUENCY TRANSLATOR 1708
DOWN CONVERT AND DELAY MODULE 1924
CONTROL SIGNAL (SAMPLING SIGNAL)
INPUT FILTER 1706
VI
VO
VO'
1908
1910
1912
1914
1916
1918
1920
1925
1926
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1904
1906
1991
1990A
1990B
1990C
1990D
1990E
1990F
1990G
1992
Y5
Y1
Φ1
Φ2

FIG. 19

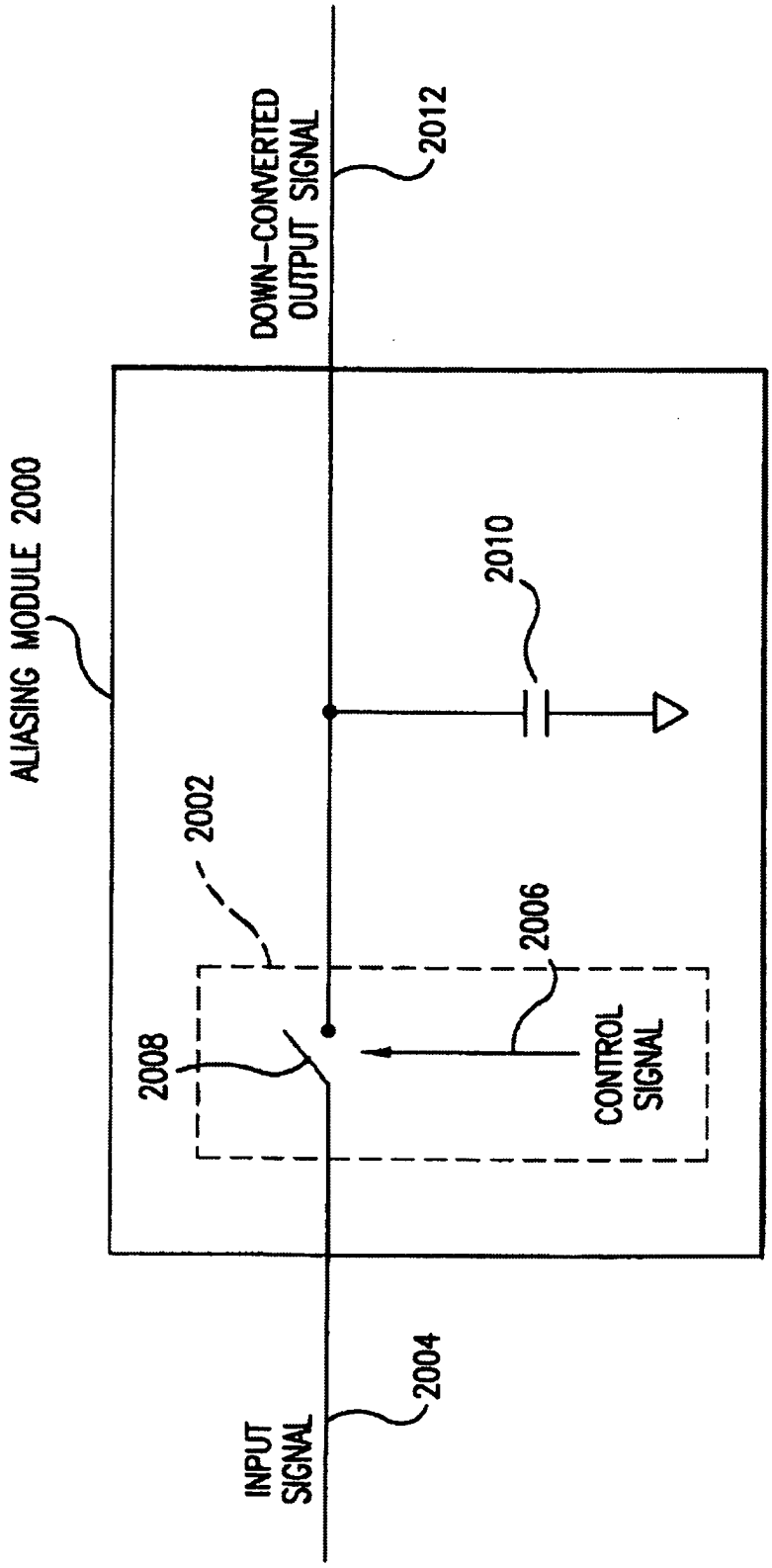

ALIASING MODULE 2000
DOWN-CONVERTED OUTPUT SIGNAL
2012
2010
2002
2006
2008
CONTROL SIGNAL
INPUT SIGNAL
2004

FIG. 20A

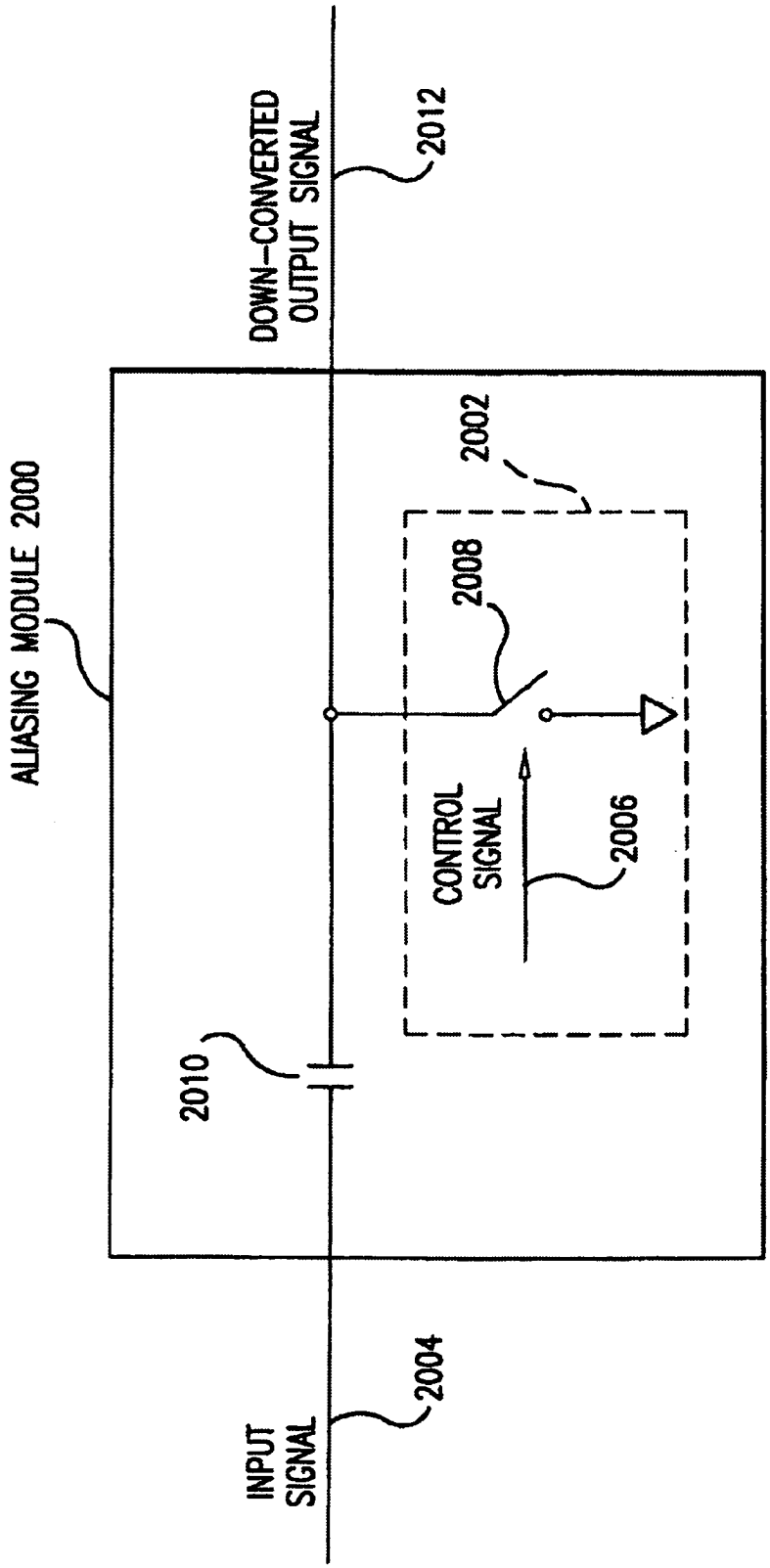

DOWN-CONVERTED OUTPUT SIGNAL
2012
ALIASING MODULE 2000
2002
2008
CONTROL SIGNAL
2006
2010
INPUT SIGNAL
2004

FIG. 20A-1

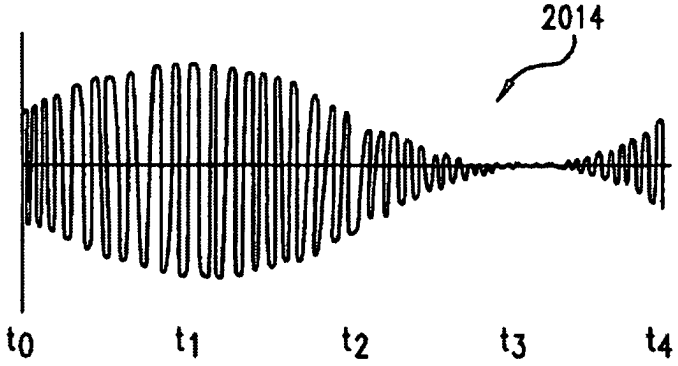


FIG. 20B

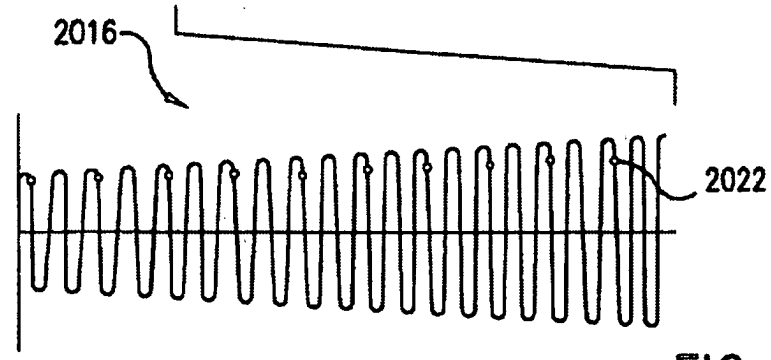


FIG. 20C

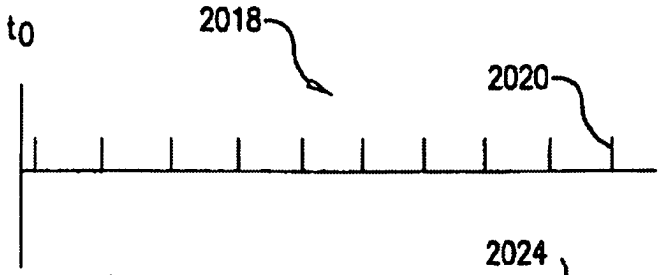


FIG. 20D

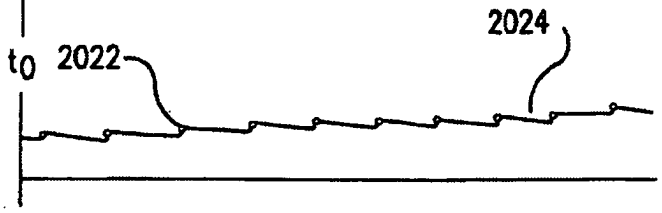


FIG. 20E

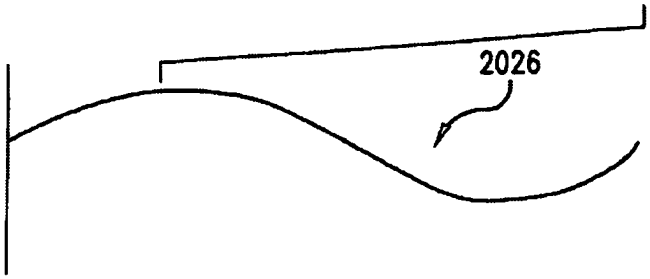


FIG. 20F

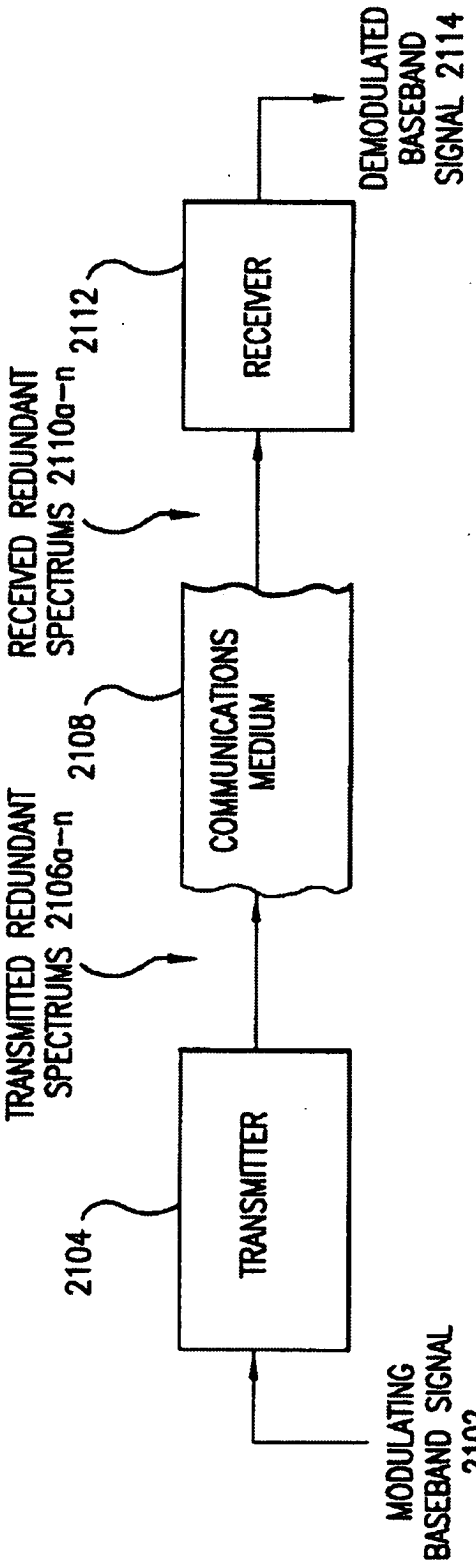

MODULATING BASEBAND SIGNAL 2102
2104
TRANSMITTER
TRANSMITTED REDUNDANT SPECTRUMS 2106a-n
2108
COMMUNICATIONS MEDIUM
RECEIVED REDUNDANT SPECTRUMS 2110a-n
2112
RECEIVER
DEMODULATED BASEBAND SIGNAL 2114

FIG. 21

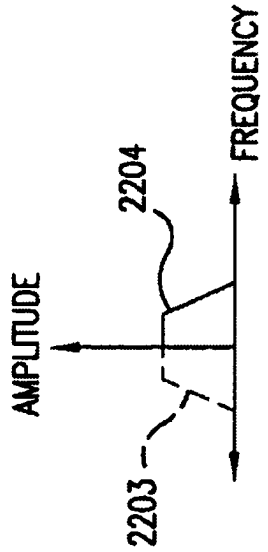


FIG. 22B

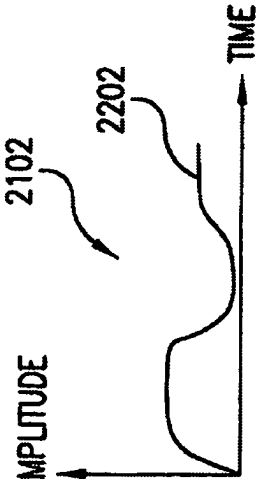


FIG. 22A

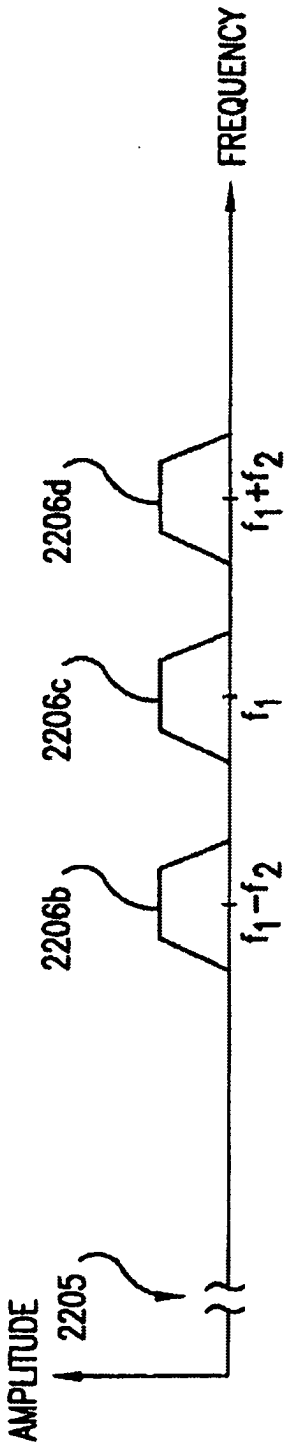


FIG. 22C

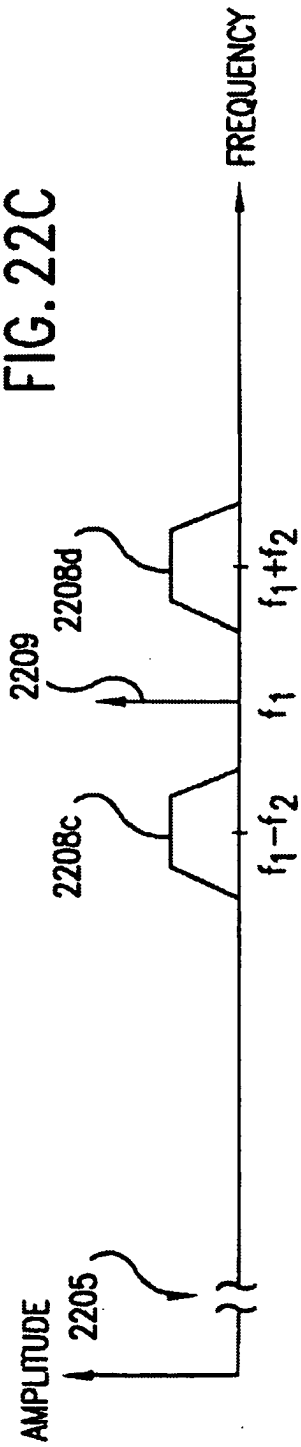


FIG. 22D

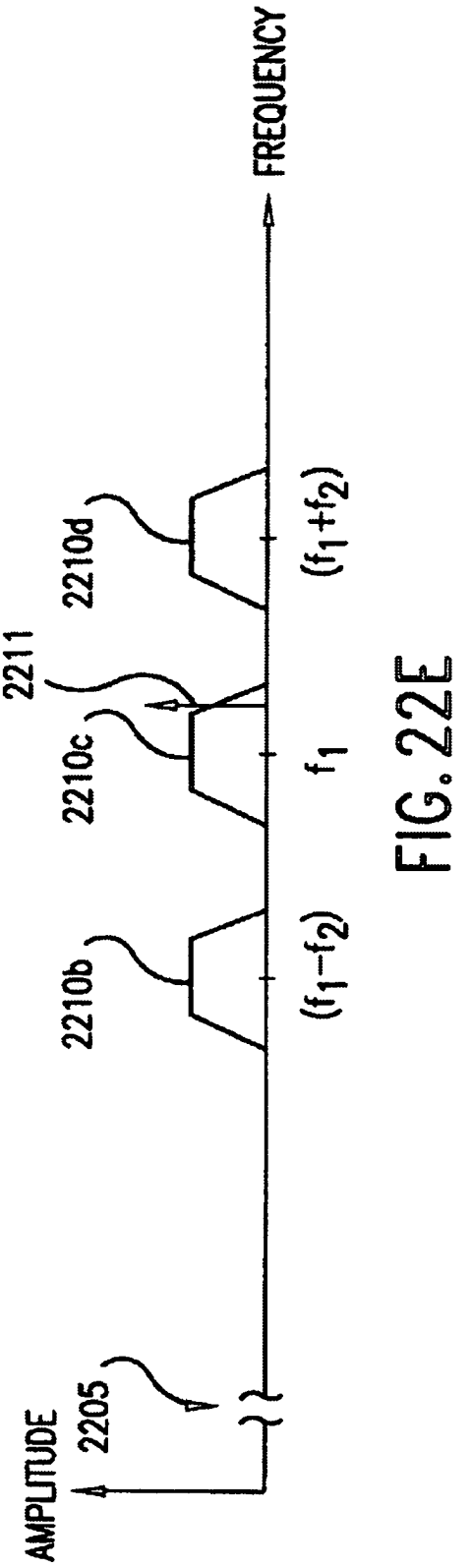


FIG. 22E

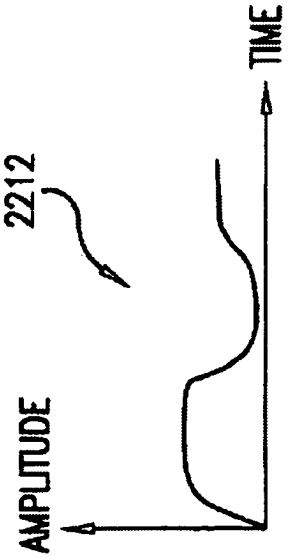


FIG. 22F

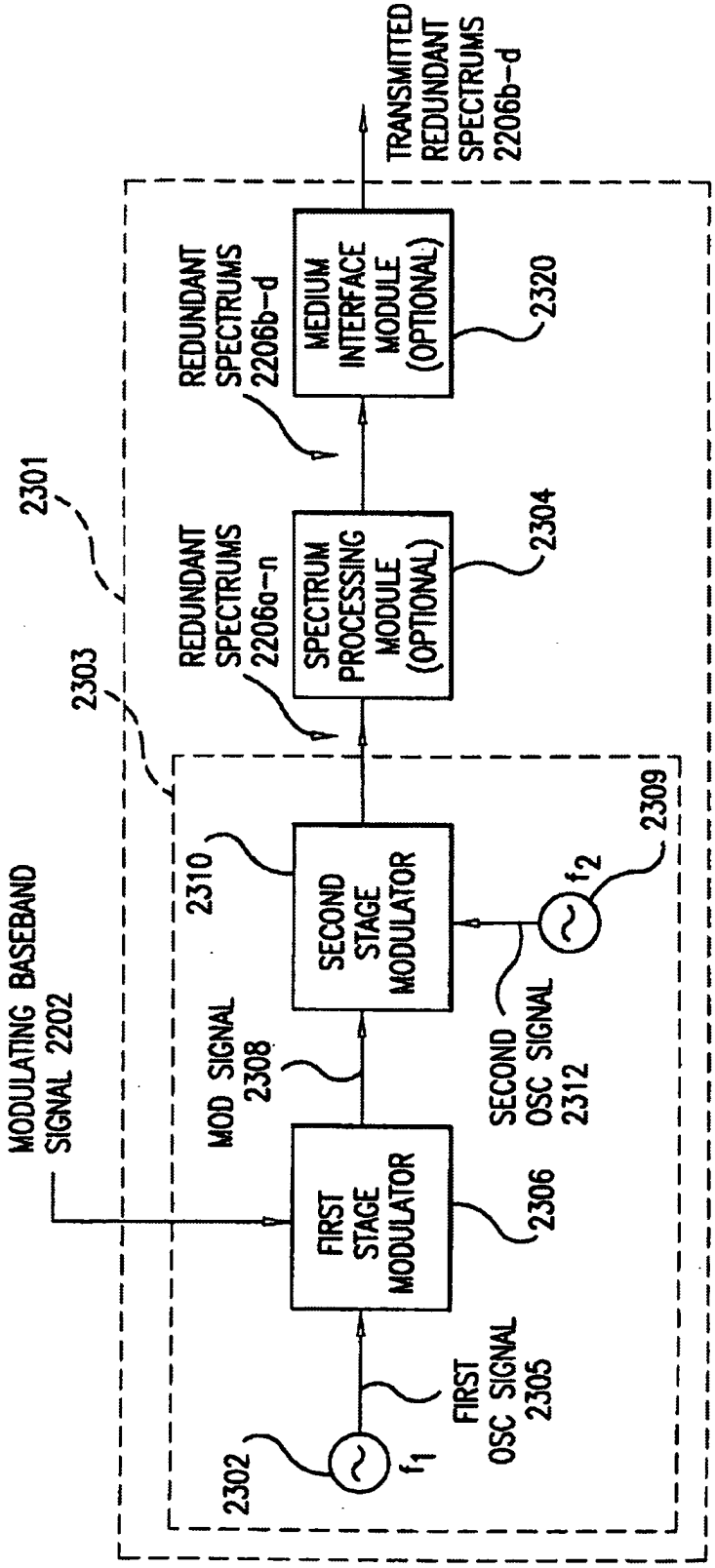

TRANSMITTED REDUNDANT SPECTRUMS 2206b–d
MEDIUM INTERFACE MODULE (OPTIONAL)
2320
REDUNDANT SPECTRUMS 2206b–d
SPECTRUM PROCESSING MODULE (OPTIONAL)
2304
REDUNDANT SPECTRUMS 2206a–n
2301
2303
2310
SECOND STAGE MODULATOR
2309
f_2
MODULATING BASEBAND SIGNAL 2202
MOD SIGNAL 2308
SECOND OSC SIGNAL 2312
FIRST STAGE MODULATOR
2306
FIRST OSC SIGNAL 2305
2302
f_1

FIG. 23A

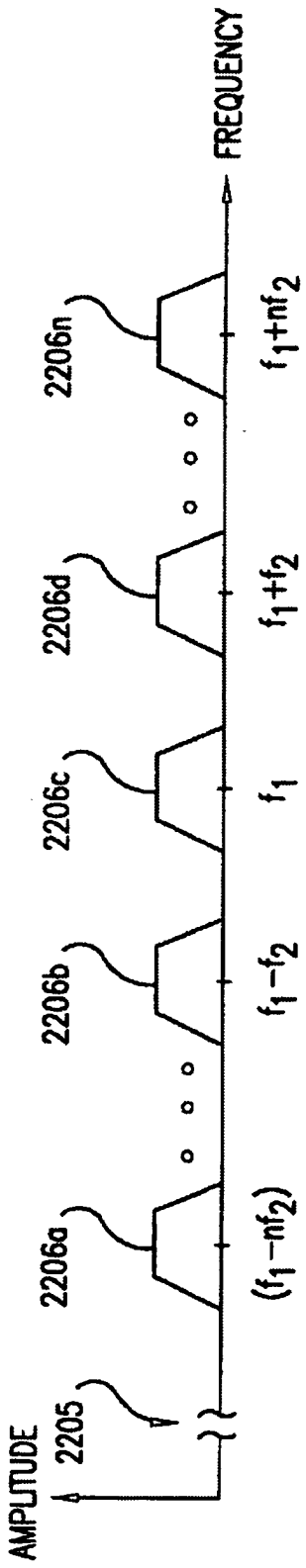


FIG. 23B

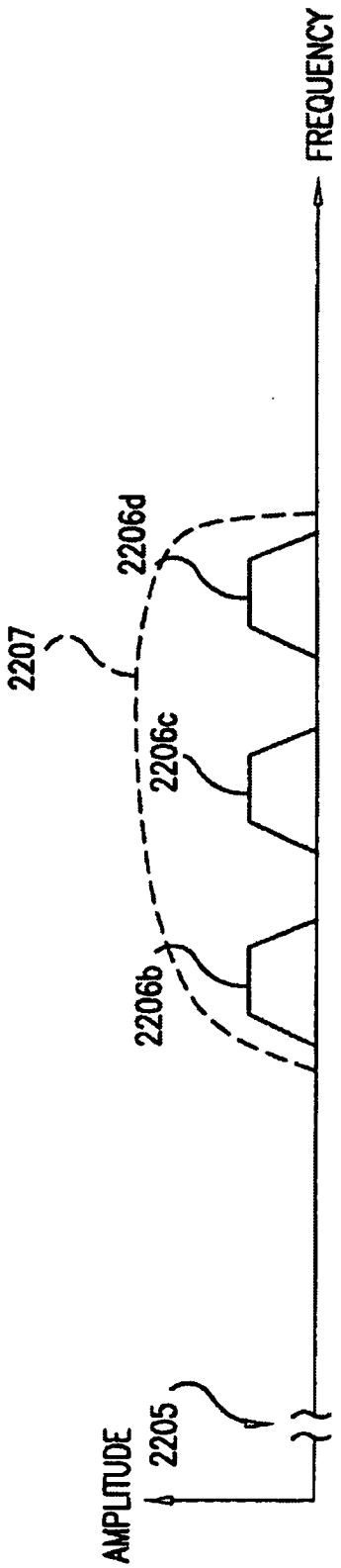


FIG. 23C

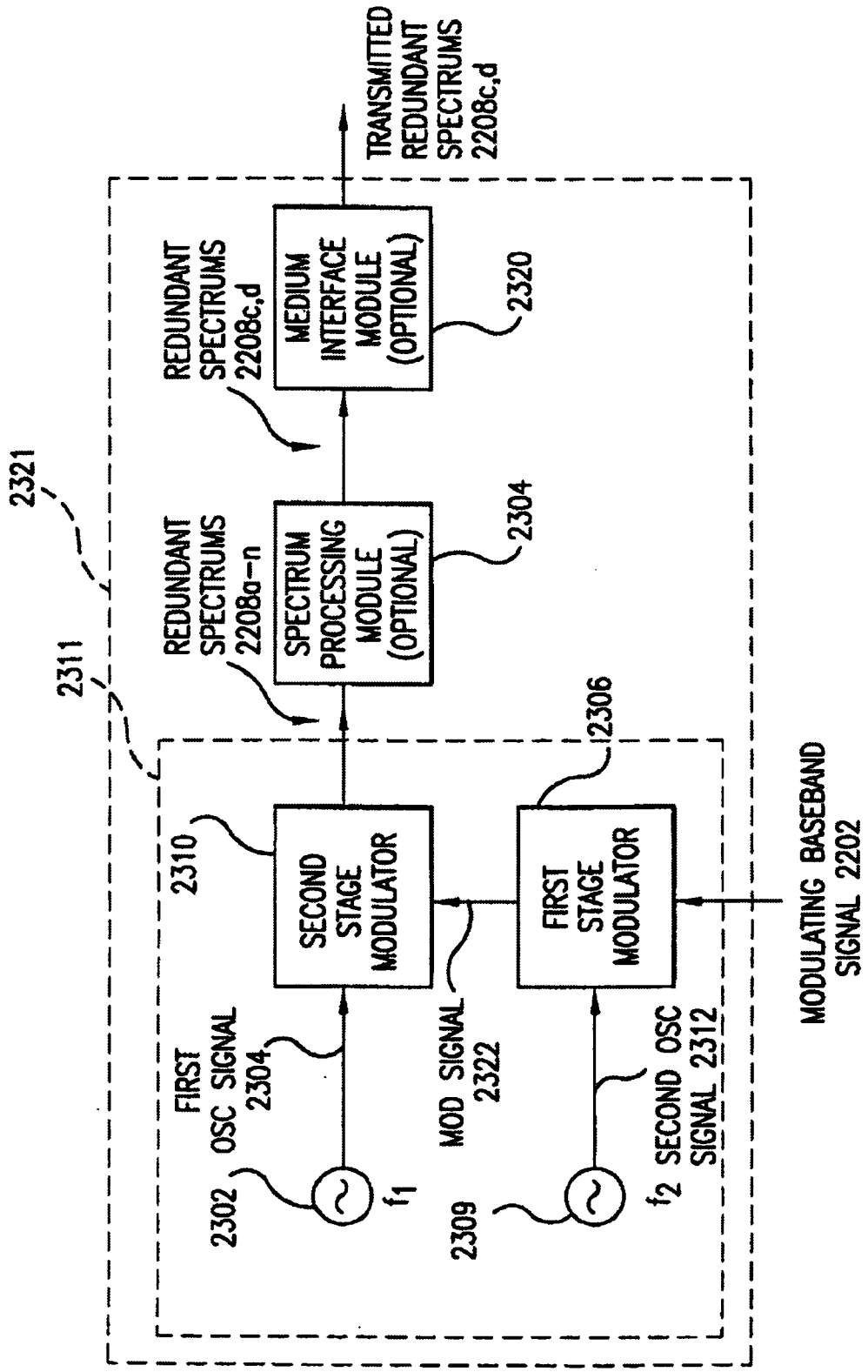

TRANSMITTED REDUNDANT SPECTRUMS 2208c,d
REDUNDANT SPECTRUMS 2208c,d
MEDIUM INTERFACE MODULE (OPTIONAL)
2320
2321
REDUNDANT SPECTRUMS 2208a-n
SPECTRUM PROCESSING MODULE (OPTIONAL)
2304
2311
2306
2310
SECOND STAGE MODULATOR
FIRST STAGE MODULATOR
MODULATING BASEBAND SIGNAL 2202
FIRST OSC SIGNAL 2304
MOD SIGNAL 2322
2302
f1
2309
f2 SECOND OSC SIGNAL 2312

FIG. 23D

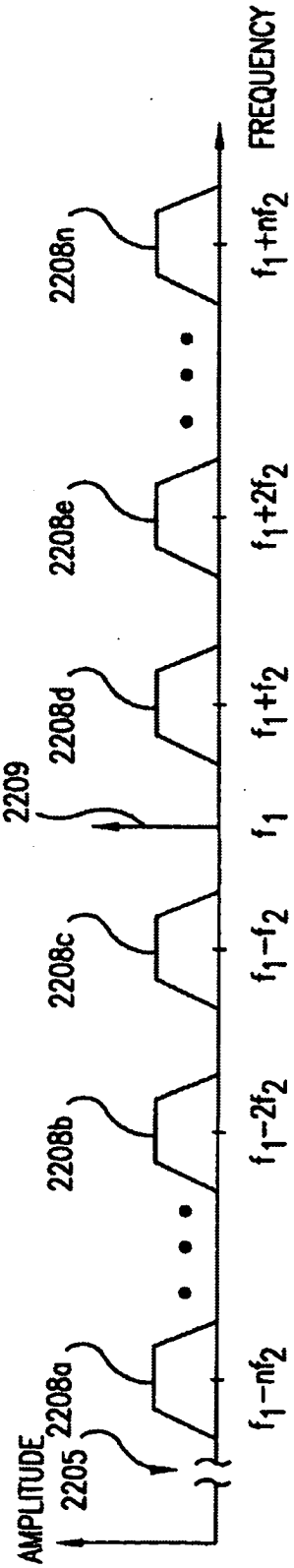


FIG. 23E

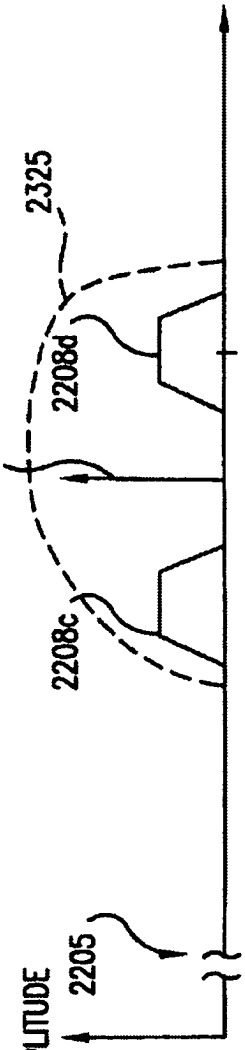


FIG. 23F

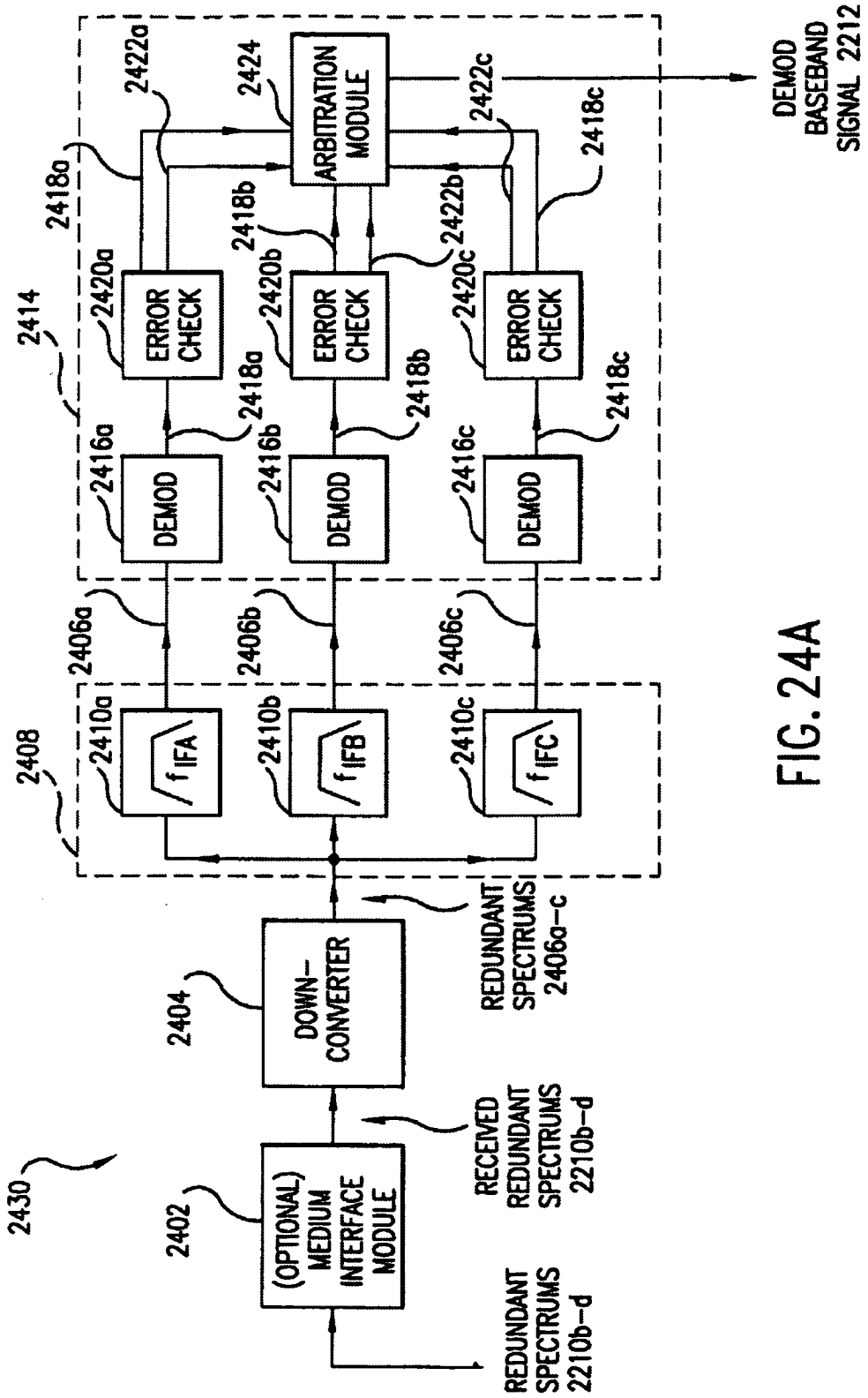

2430
2402
(OPTIONAL) MEDIUM INTERFACE MODULE
REDUNDANT SPECTRUMS 2210b-d
RECEIVED REDUNDANT SPECTRUMS 2210b-d
2404
DOWN-CONVERTER
REDUNDANT SPECTRUMS 2406a-c
2408
2410a
f_{IFA}
2410b
f_{IFB}
2410c
f_{IFC}
2406a
2406b
2406c
2414
2416a
DEMOD
2416b
DEMOD
2416c
DEMOD
2418a
2418b
2418c
2420a
ERROR CHECK
2420b
ERROR CHECK
2420c
ERROR CHECK
2422a
2422b
2422c
2424
ARBITRATION MODULE
DEMOD BASEBAND SIGNAL 2212

FIG. 24A

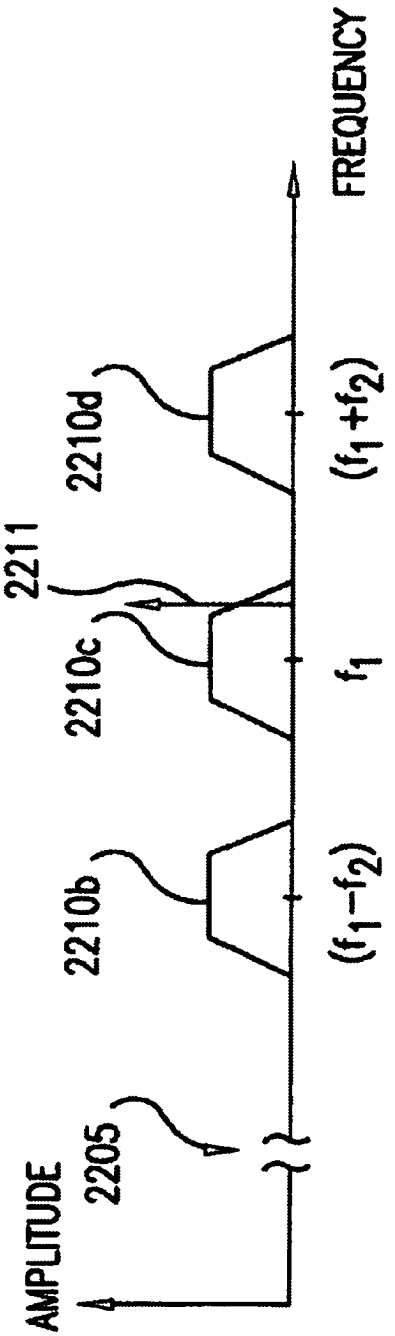


FIG. 24B

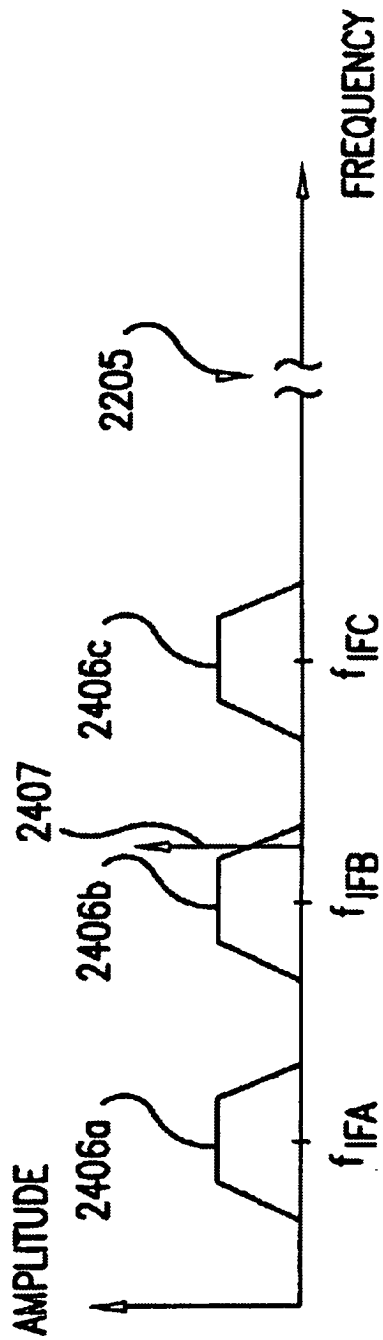


FIG. 24C

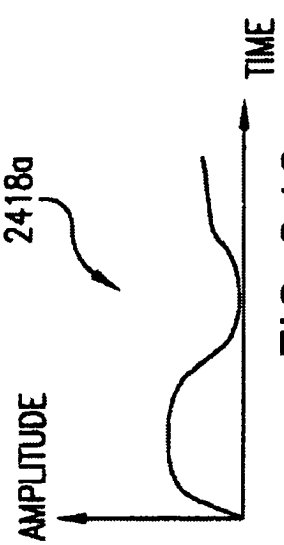


FIG. 24G

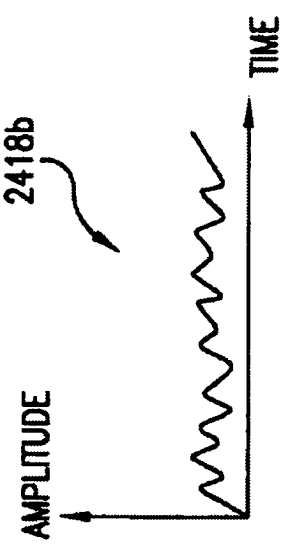


FIG. 24H

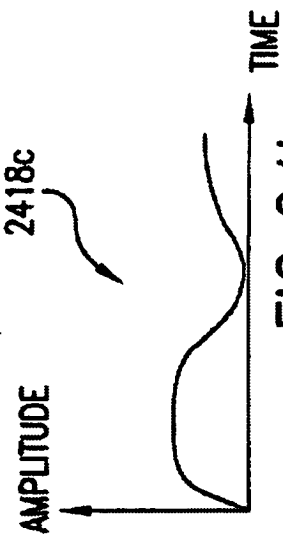


FIG. 24I

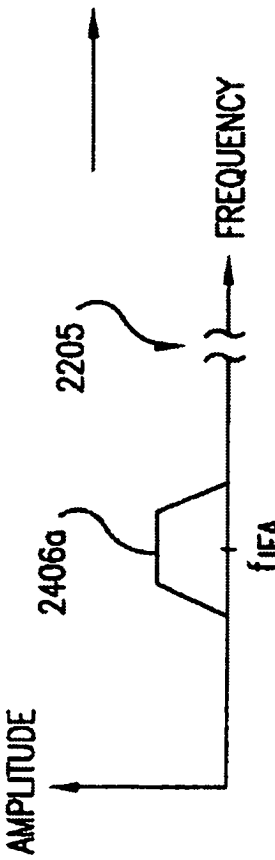


FIG. 24D

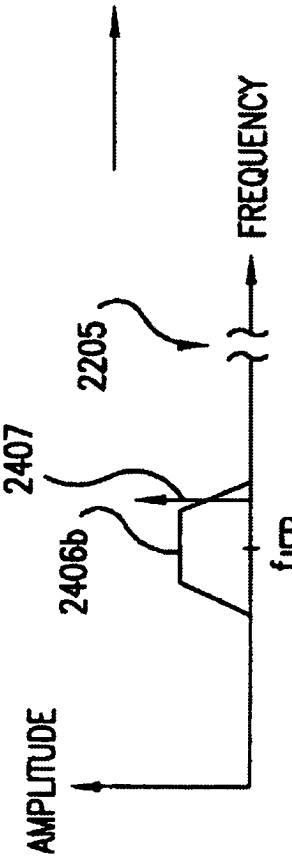


FIG. 24E

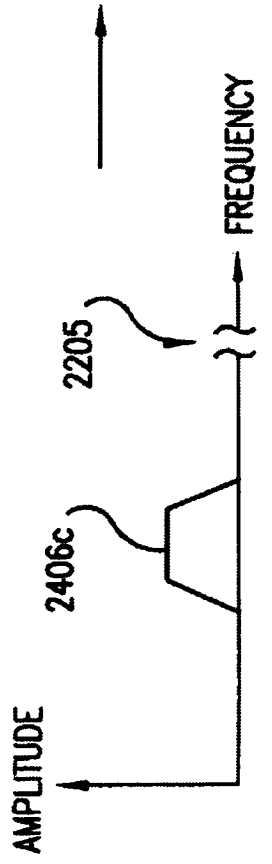


FIG. 24F

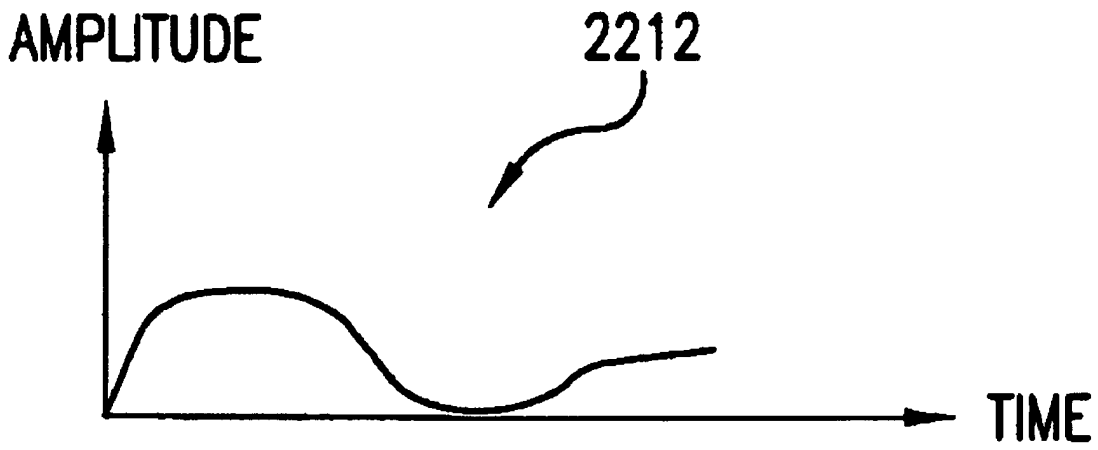


FIG. 24J

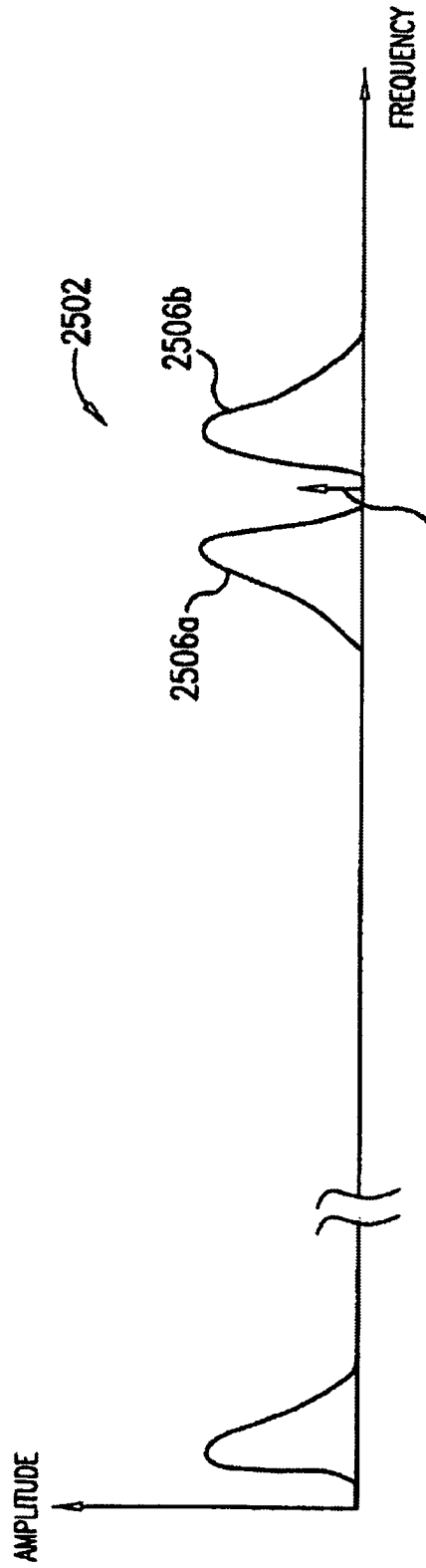


FIG.25A

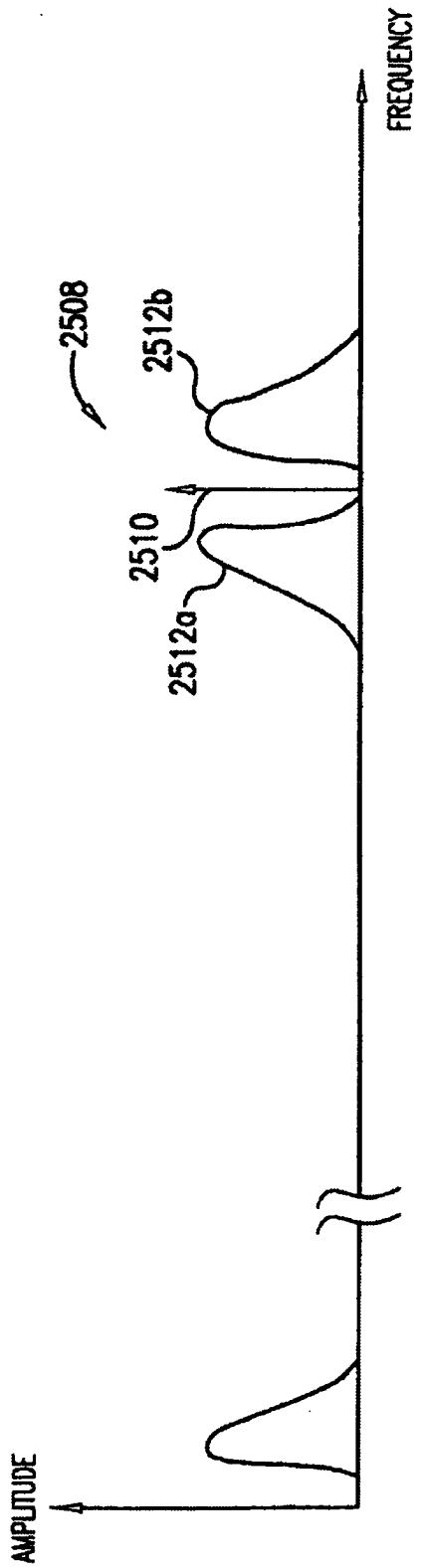


FIG.25B

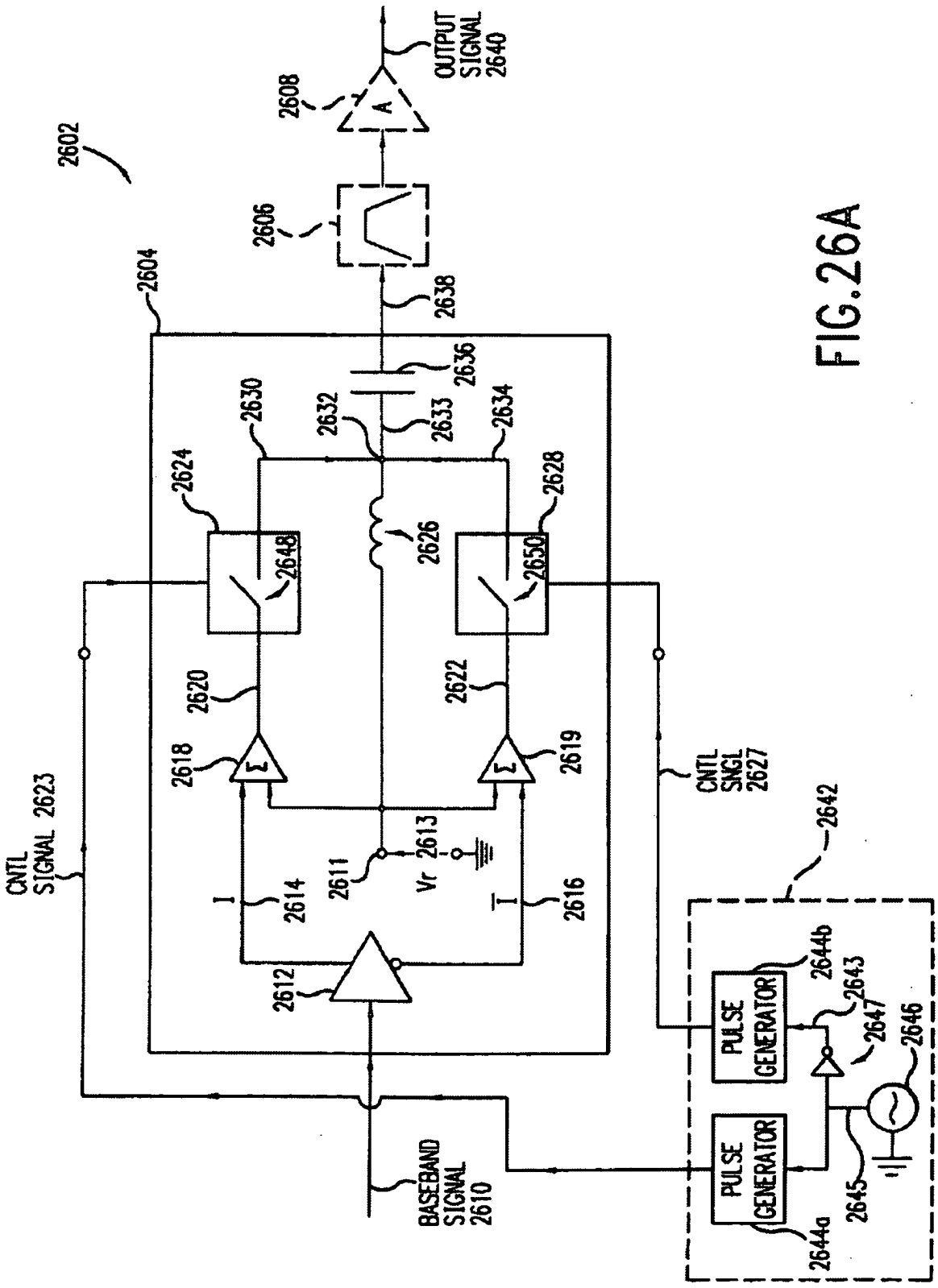

2602
2604
2606
2608
OUTPUT SIGNAL 2640
2638
2636
2630
2632
2633
2634
2624
2626
2628
2648
2650
2620
2622
2618
2619
CNTL SIGNAL 2623
CNTL SNGL 2627
2642
2613
Vr
2611
2614
2616
2612
PULSE GENERATOR
2644b
2643
2647
2646
2645
2644a
BASEBAND SIGNAL 2610

FIG. 26A

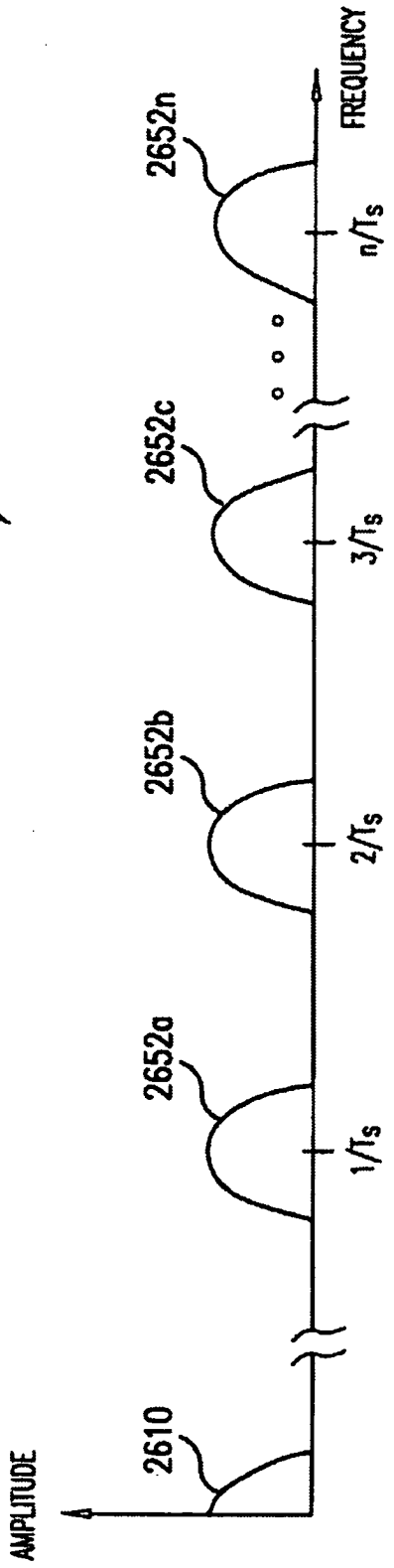

2630
2652n
2652c
2652b
2652a
2610
FREQUENCY
AMPLITUDE
n/Ts
3/Ts
2/Ts
1/Ts

FIG.26B

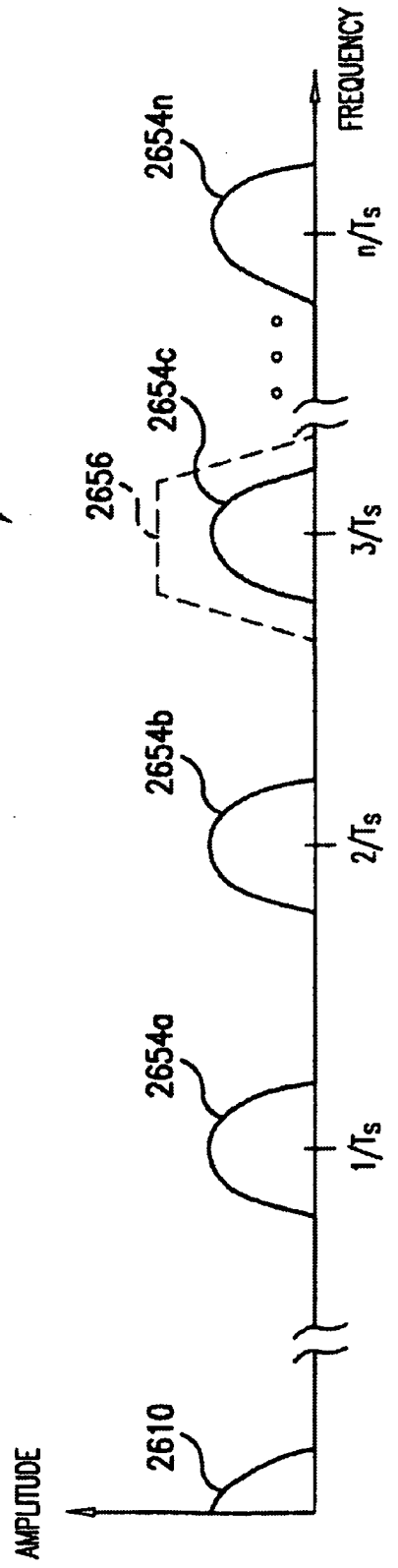

2633,2638
2654n
2654c
2656
2654b
2654a
2610
FREQUENCY
AMPLITUDE
n/Ts
3/Ts
2/Ts
1/Ts

FIG.26C

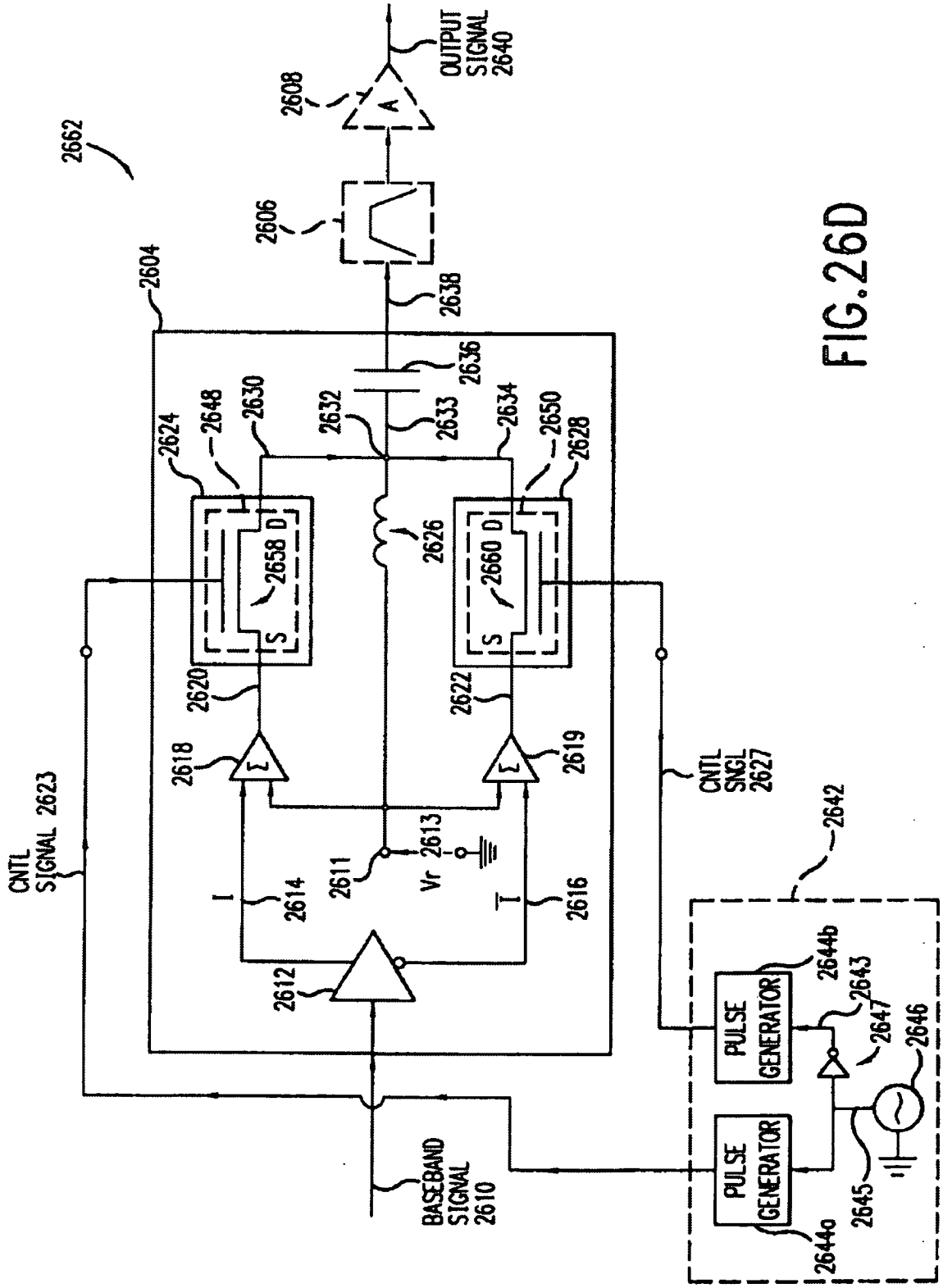

2662
2608
A
OUTPUT SIGNAL 2640
2606
2604
2638
2636
2624
2648
2630
2632
2633
2634
2650
2628
2626
2658 D
S
2660 D
S
2620
2622
2618
Σ
Σ
2619
CNTL SIGNAL 2623
CNTL SNGL 2627
2642
2611
2613
Vr
I
2614
Ī
2616
2612
PULSE GENERATOR
2644b
2643
2647
2646
2645
2644a
BASEBAND SIGNAL 2610

FIG.26D

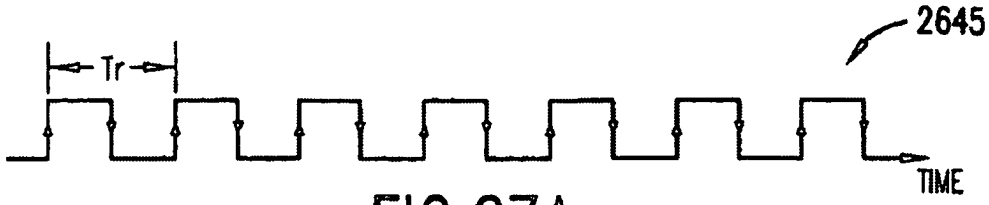


FIG.27A

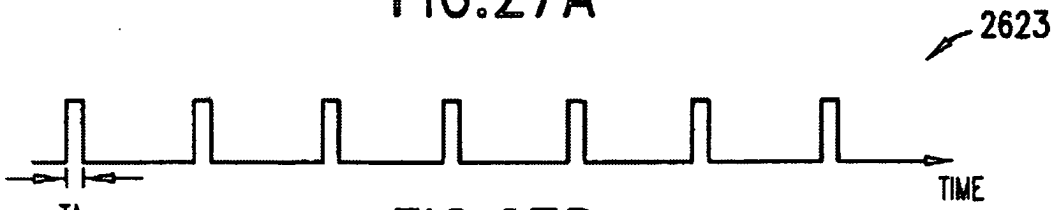


FIG.27B

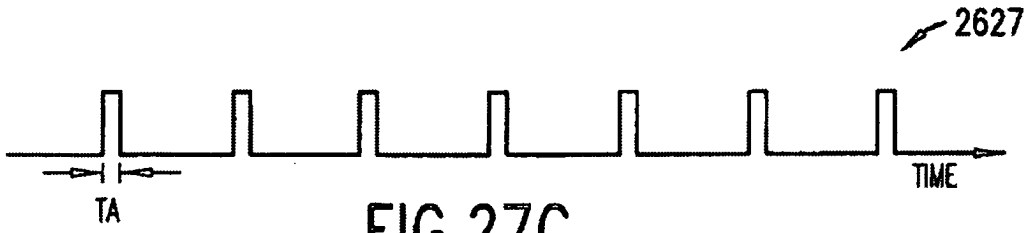


FIG.27C

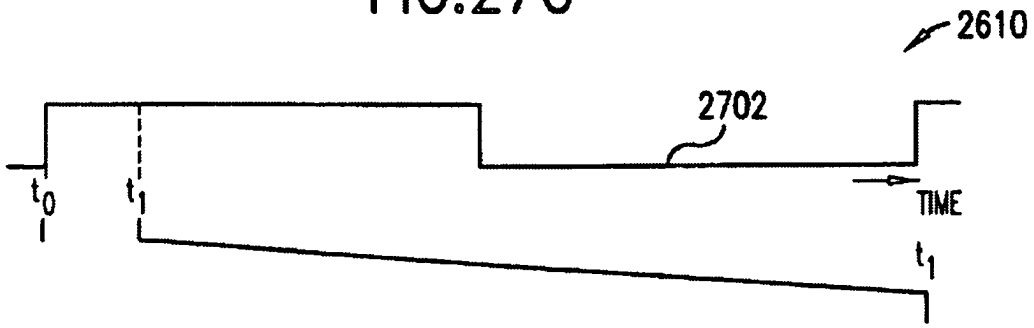


FIG.27D

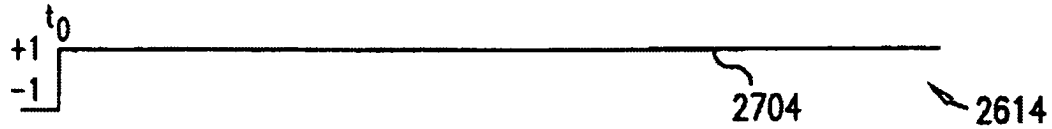


FIG.27E

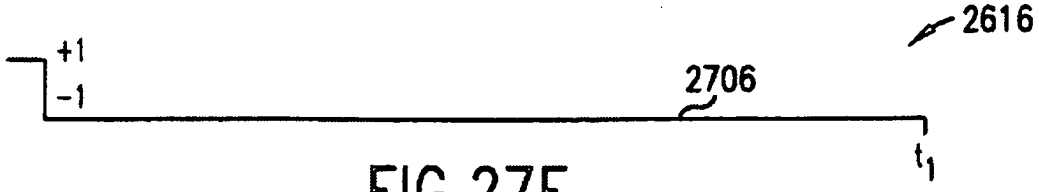


FIG.27F

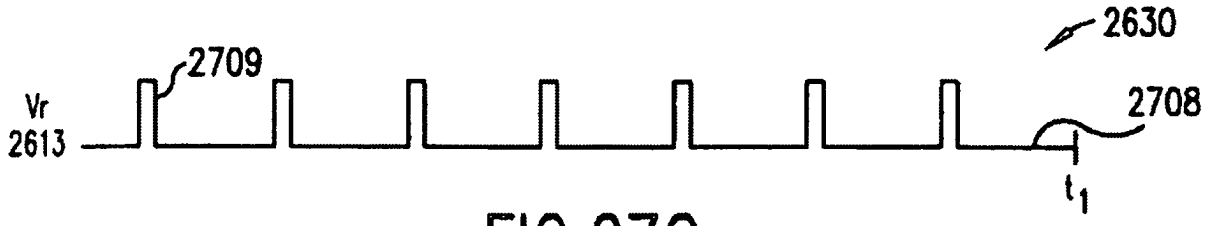


FIG.27G

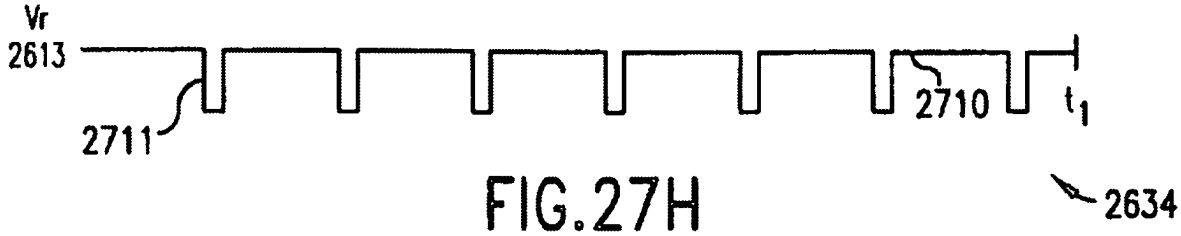


FIG.27H

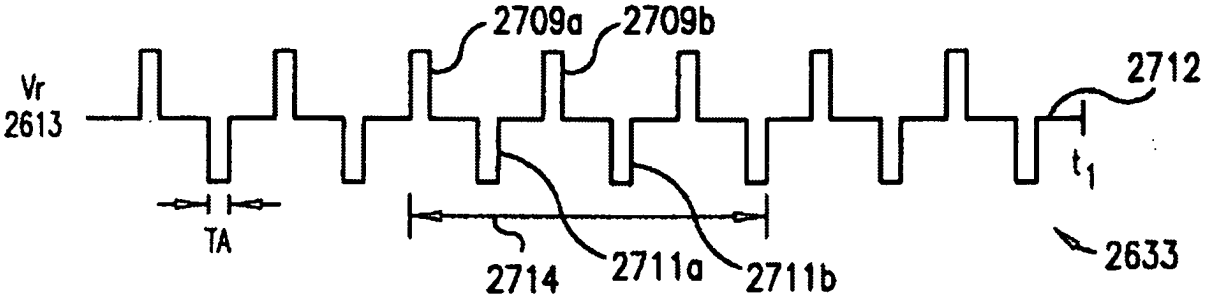


FIG.27I

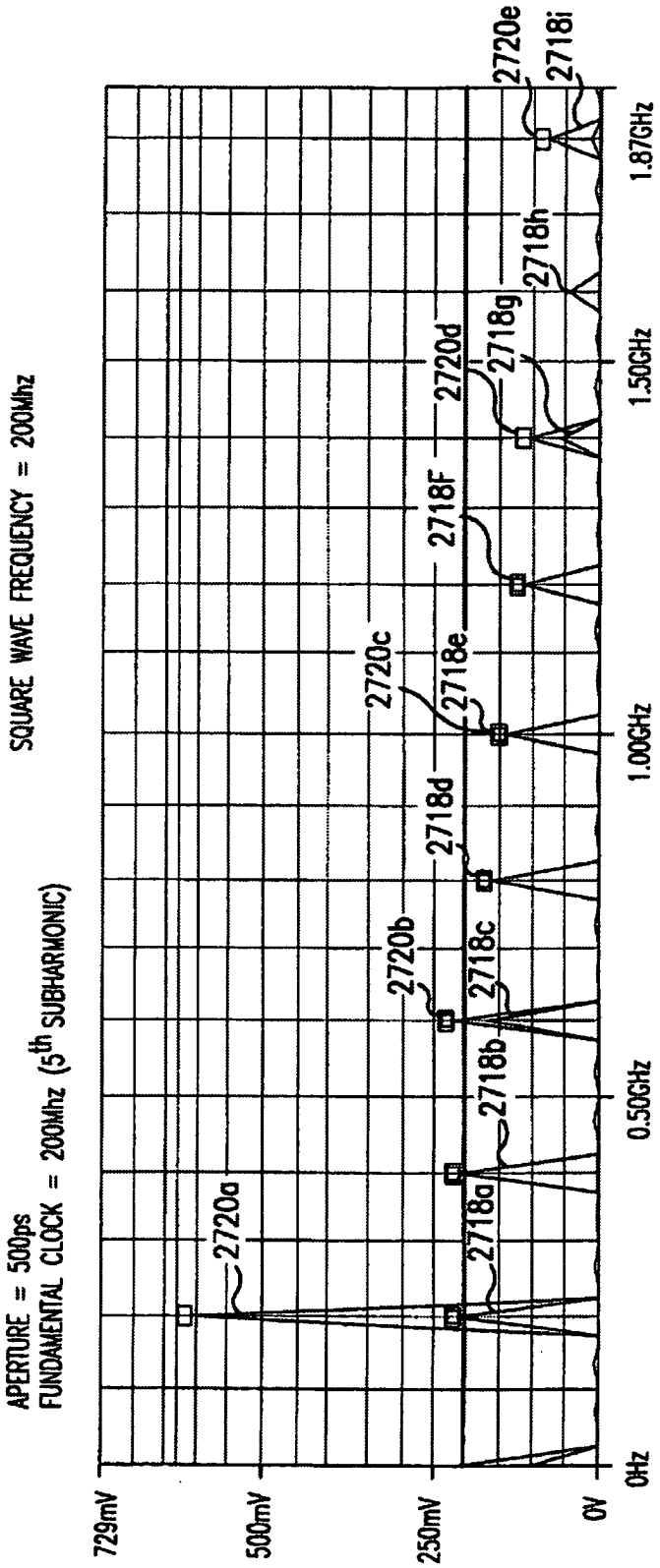

APERTURE = 500ps
FUNDAMENTAL CLOCK = 200Mhz (5th SUBHARMONIC)
SQUARE WAVE FREQUENCY = 200Mhz
729mV
500mV
250mV
0V
0Hz
0.50GHz
1.00GHz
1.50GHz
1.87GHz
FREQUENCY
V
V (SQUARE_WAVE)
2720a
2720b
2720c
2720d
2720e
2718a
2718b
2718c
2718d
2718e
2718F
2718g
2718h
2718i

FIG. 27J

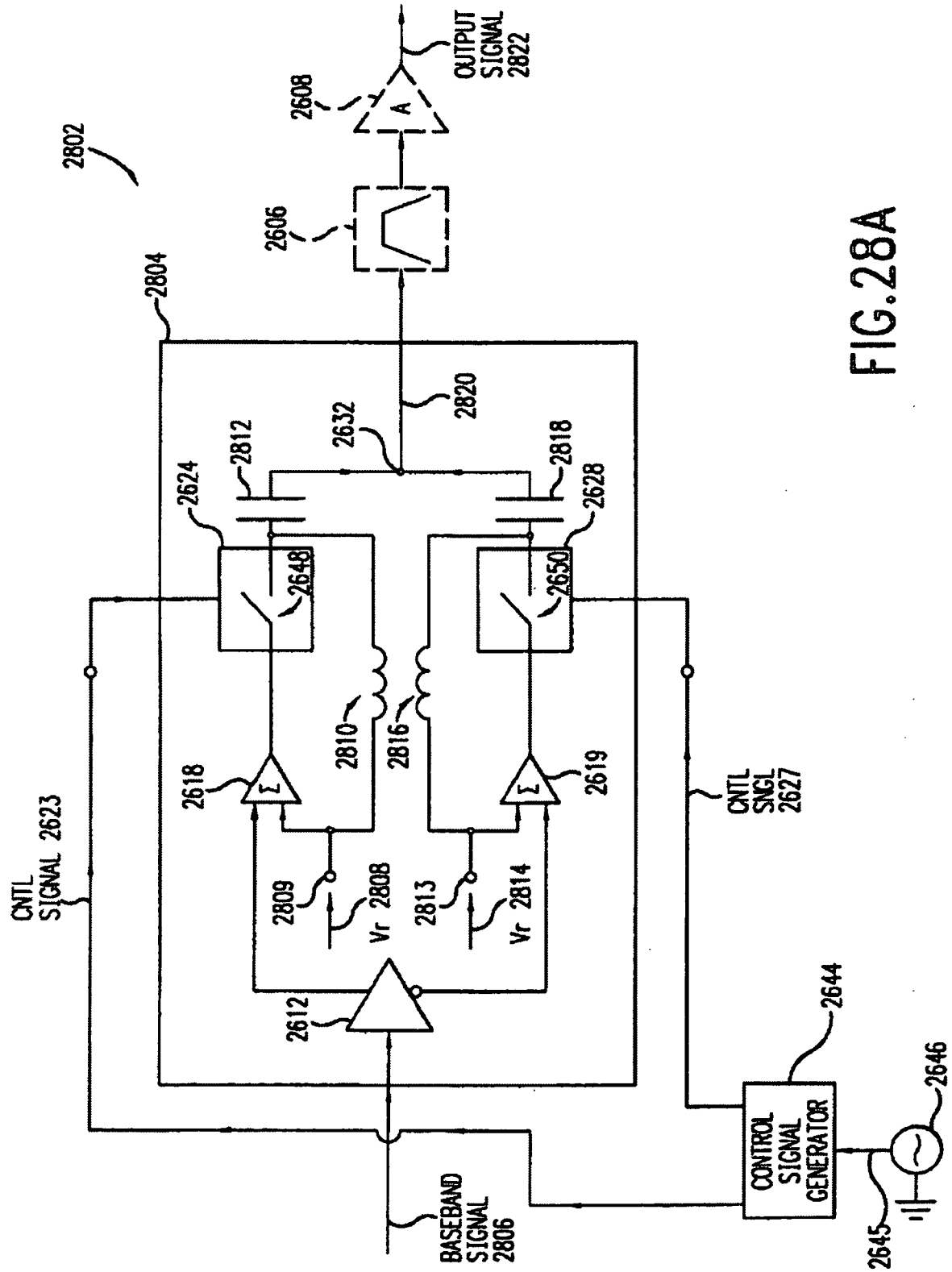

2802
2804
2608
A
OUTPUT SIGNAL 2822
2606
2820
2632
2812
2818
2624
2628
2648
2650
2810
2816
2618
2619
CNTL SIGNAL 2623
CNTL SNGL 2627
2809
Vr 2808
2813
Vr 2814
2612
2644
2646
CONTROL SIGNAL GENERATOR
2645
BASEBAND SIGNAL 2806

FIG.28A

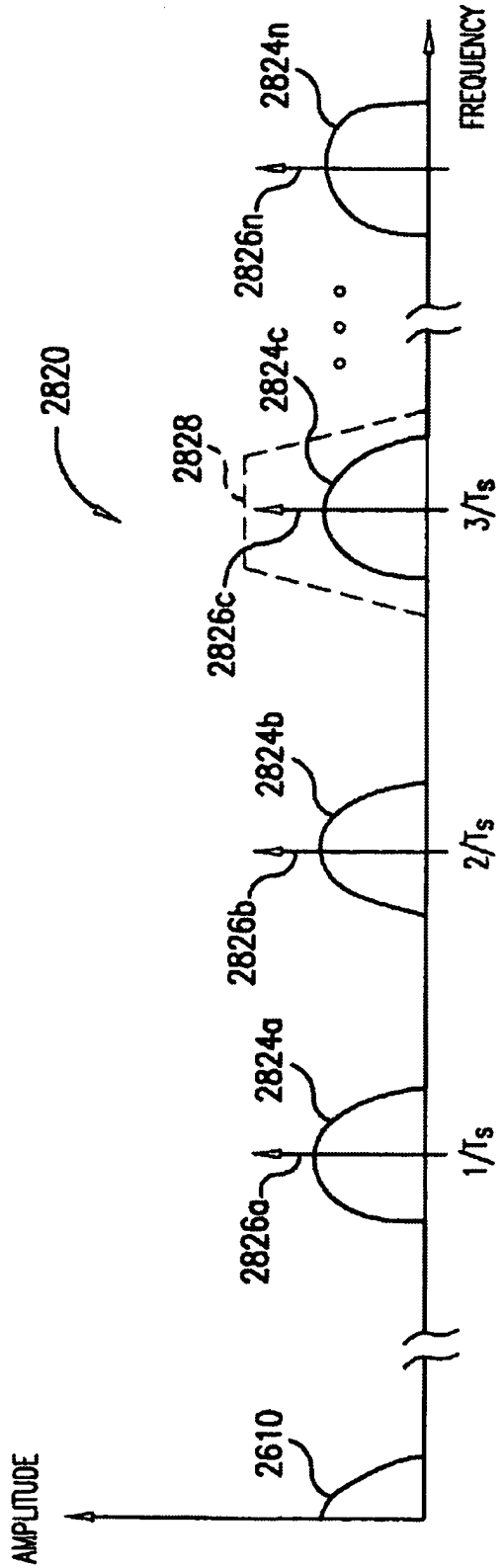

2820
AMPLITUDE
FREQUENCY
2610
2824a
2826a
2824b
2826b
2824c
2826c
2828
2824n
2826n
1/Ts
2/Ts
3/Ts

FIG.28B

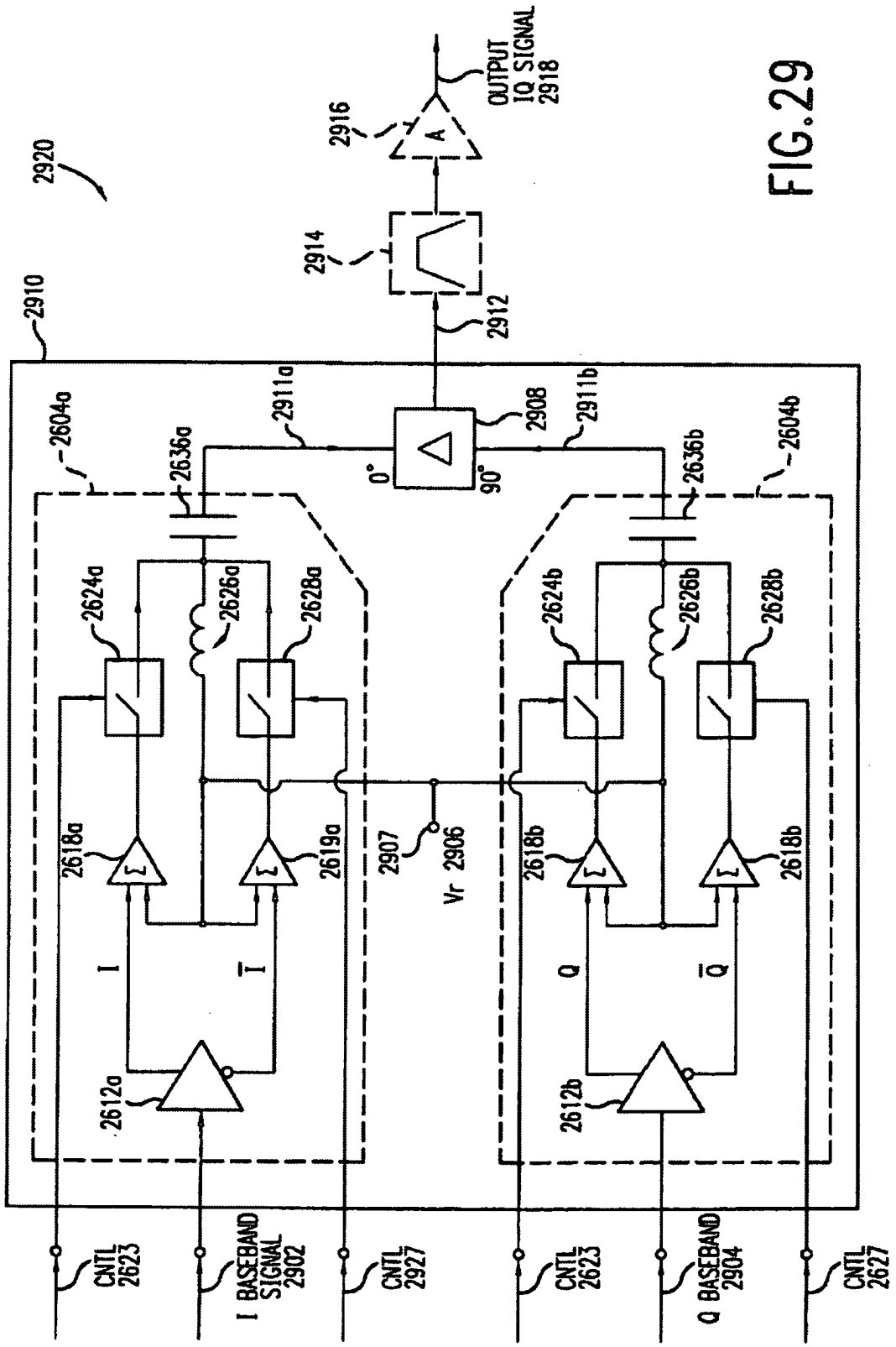

OUTPUT IQ SIGNAL 2918
2916
2920
2914
2912
2910
2911a
2908
2911b
2604a
2636a
0°
90°
2636b
2604b
2624a
2626a
2628a
2624b
2626b
2628b
2618a
2619a
2907
Vr 2906
2618b
2618b
I
Ī
Q
Q̄
2612a
2612b
CNTL 2623
I BASEBAND SIGNAL 2902
CNTL 2927
CNTL 2623
Q BASEBAND 2904
CNTL 2627

FIG. 29

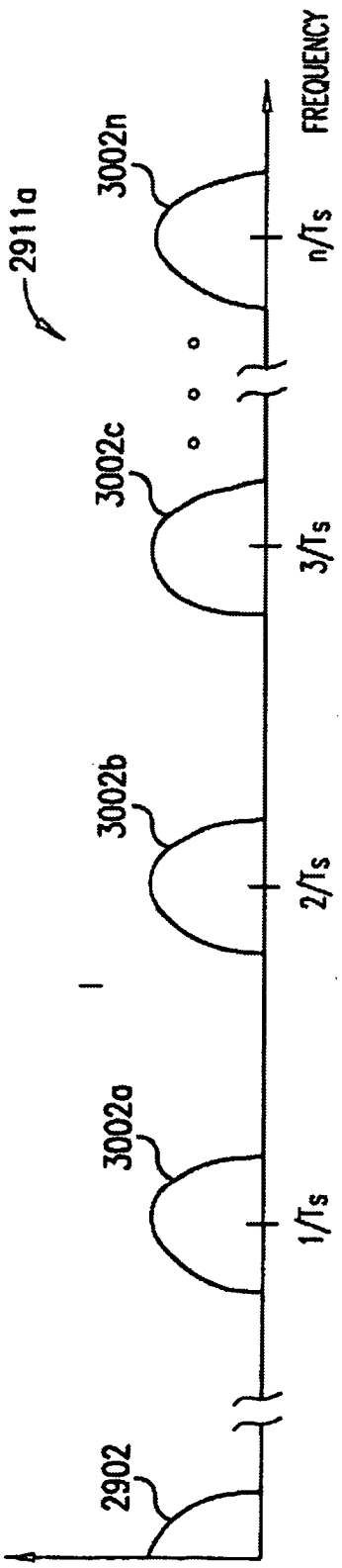


FIG.30A

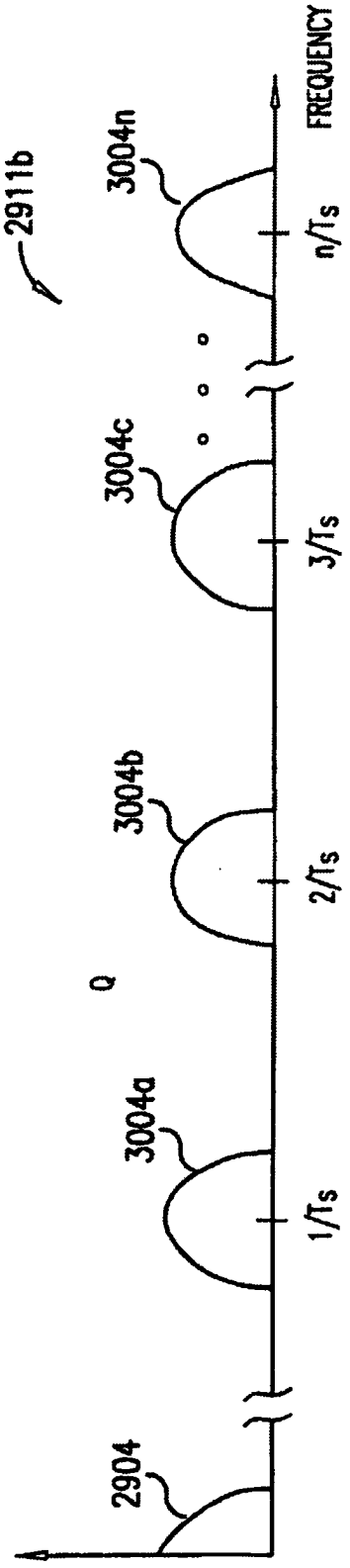


FIG.30B

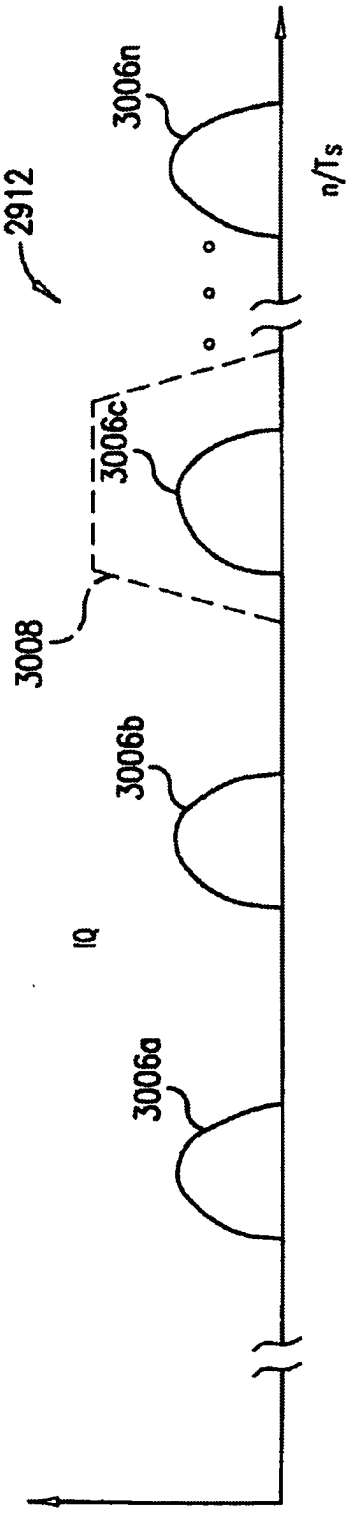


FIG.30C

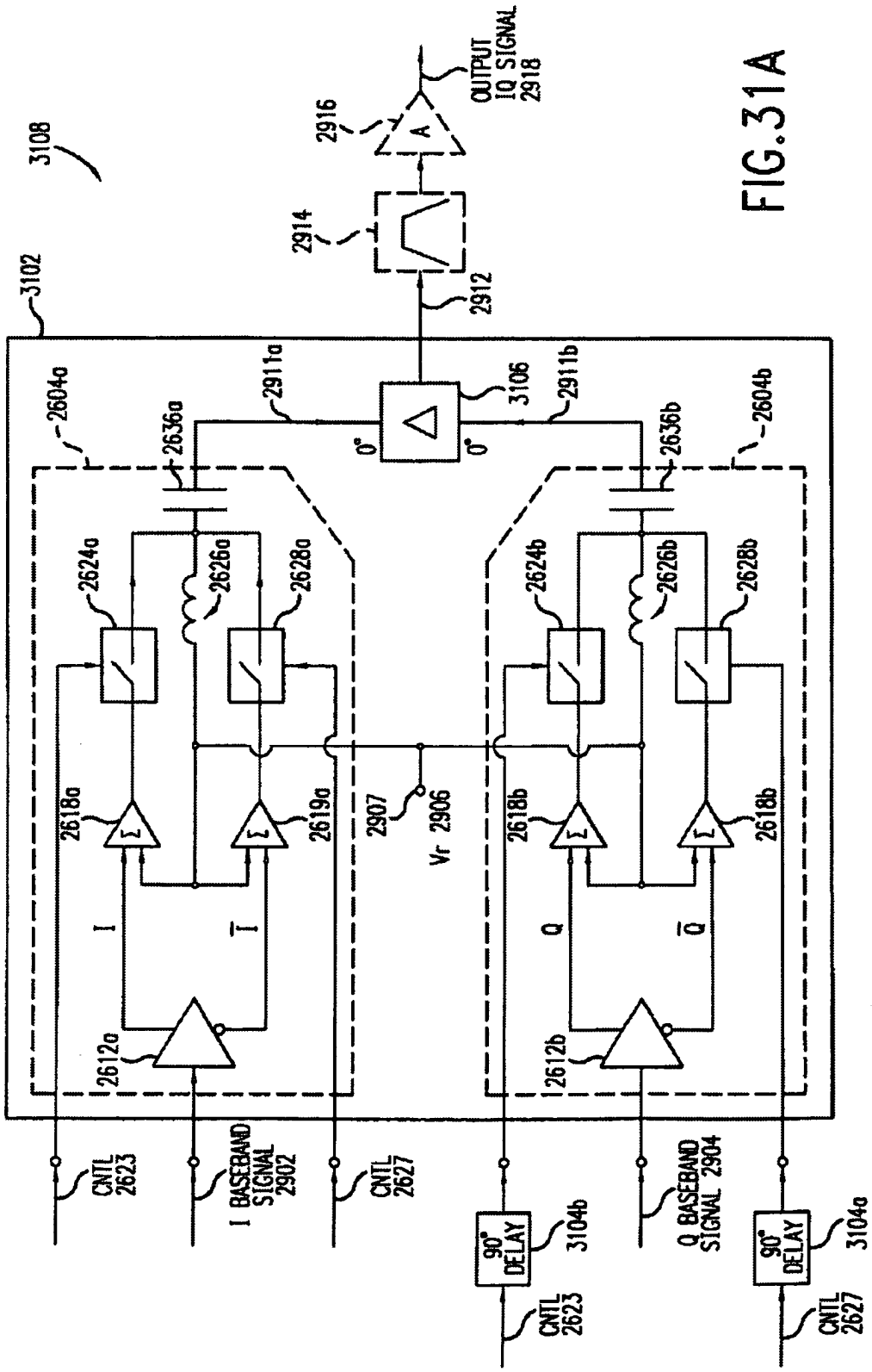

3108
3102
2916
2914
2912
OUTPUT IQ SIGNAL 2918
2911a
2911b
3106
0°
0°
2604a
2604b
2636a
2636b
2624a
2626a
2628a
2624b
2626b
2628b
2618a
2619a
2907
Vr 2906
2618b
I
Ī
Q
Q̄
2612a
2612b
CNTL 2623
1 BASEBAND SIGNAL 2902
CNTL 2627
90° DELAY
3104b
Q BASEBAND SIGNAL 2904
90° DELAY
3104a
CNTL 2623
CNTL 2627

FIG.31A

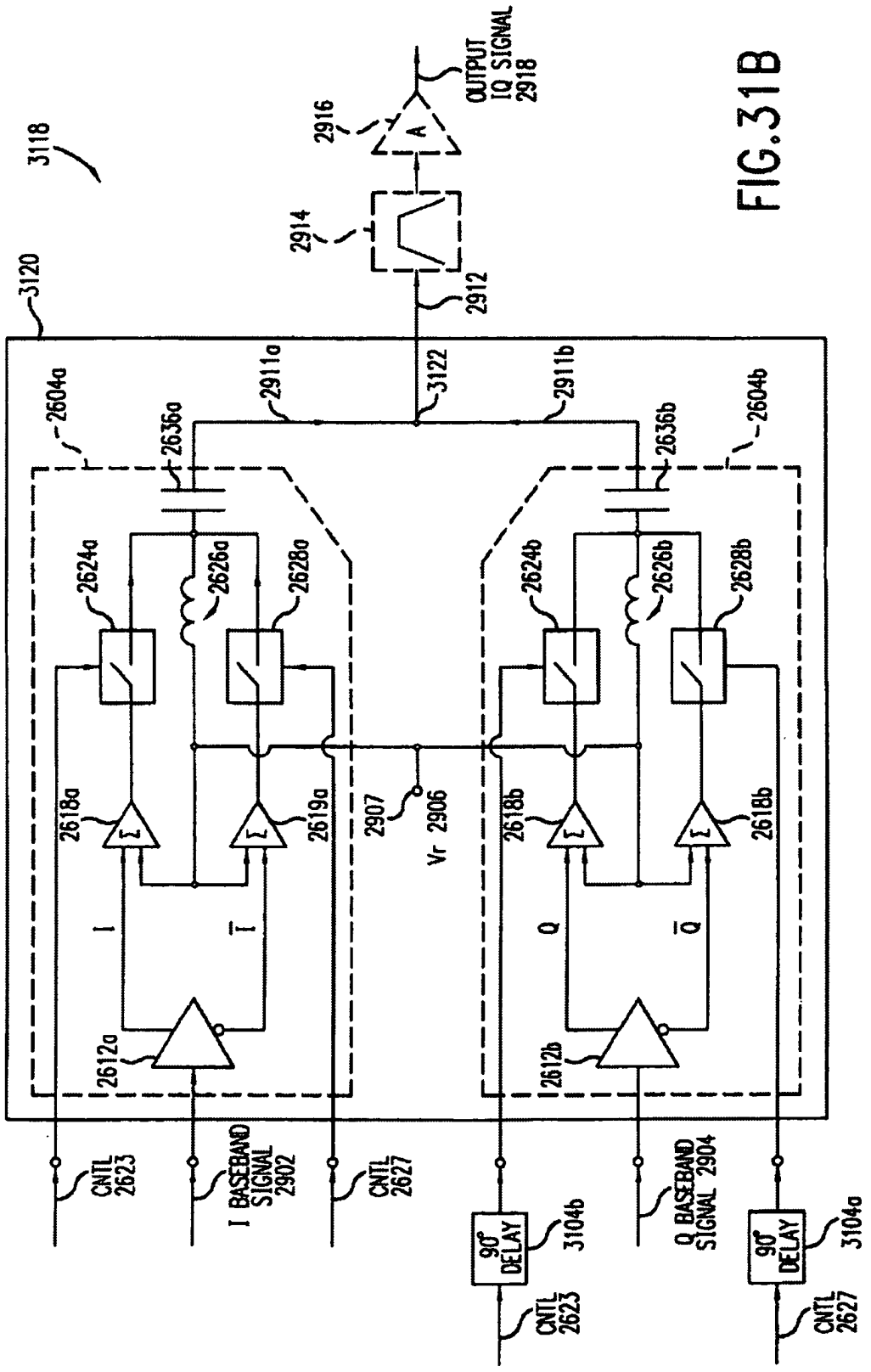

3118
3120
2916
OUTPUT IQ SIGNAL 2918
2914
2912
3122
2911a
2911b
2604a
2604b
2636a
2636b
2624a
2626a
2628a
2624b
2626b
2628b
2618a
2619a
2618b
2907
Vr 2906
I
Ī
Q
Q̄
2612a
2612b
CNTL 2623
I BASEBAND SIGNAL 2902
CNTL 2627
90° DELAY 3104b
Q BASEBAND SIGNAL 2904
90° DELAY 3104a
CNTL 2623
CNTL 2627

FIG.31B

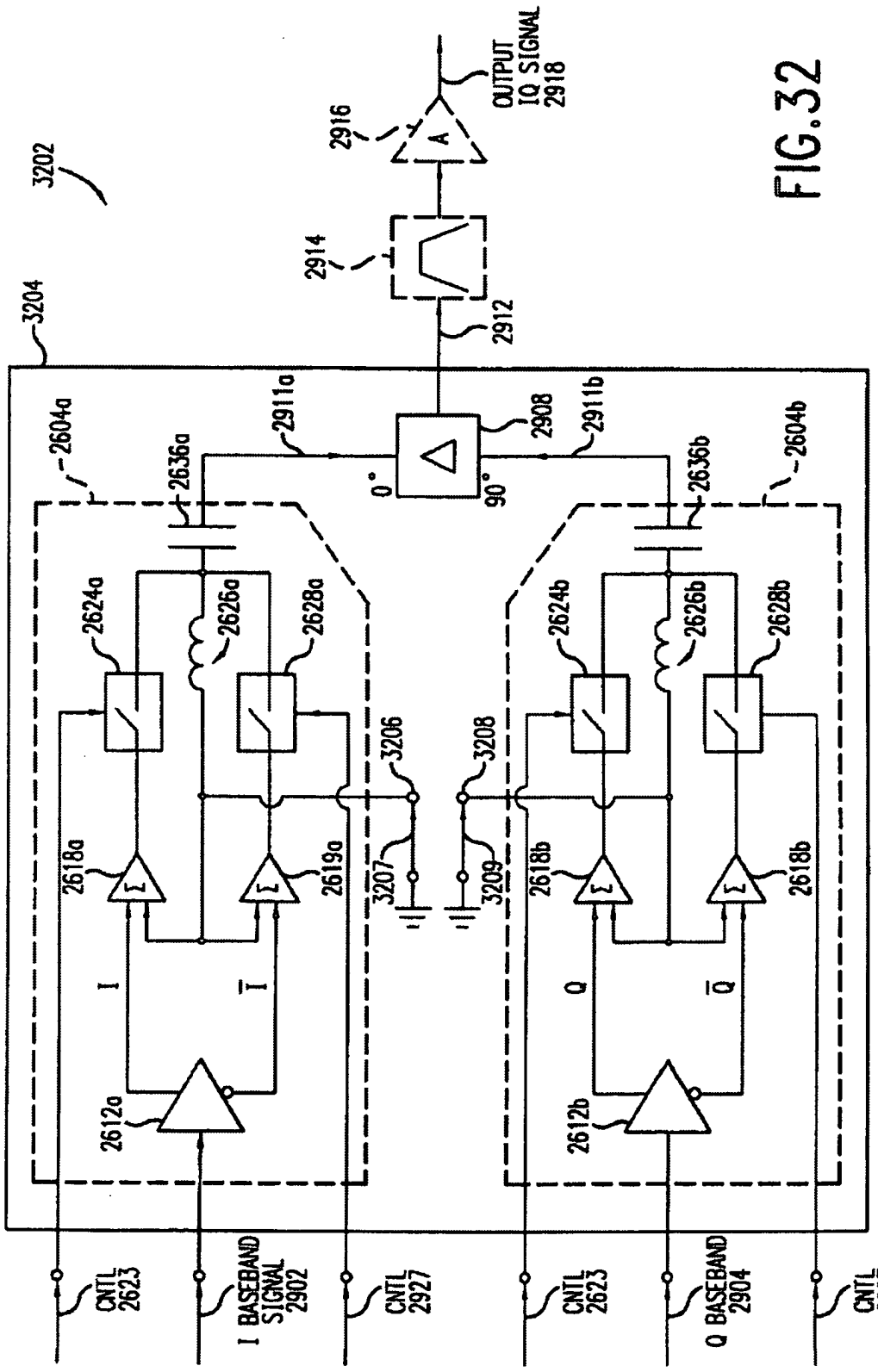

3202
3204
2916
OUTPUT IQ SIGNAL 2918
2914
2912
2911a
2908
2911b
0°
90°
2604a
2636a
2624a
2626a
2628a
2618a
2619a
3206
3207
I
Ī
2612a
2604b
2636b
2624b
2626b
2628b
2618b
3208
3209
Q
Q̄
2612b
CNTL 2623
I BASEBAND SIGNAL 2902
CNTL 2927
CNTL 2623
Q BASEBAND 2904
CNTL 2627

FIG. 32

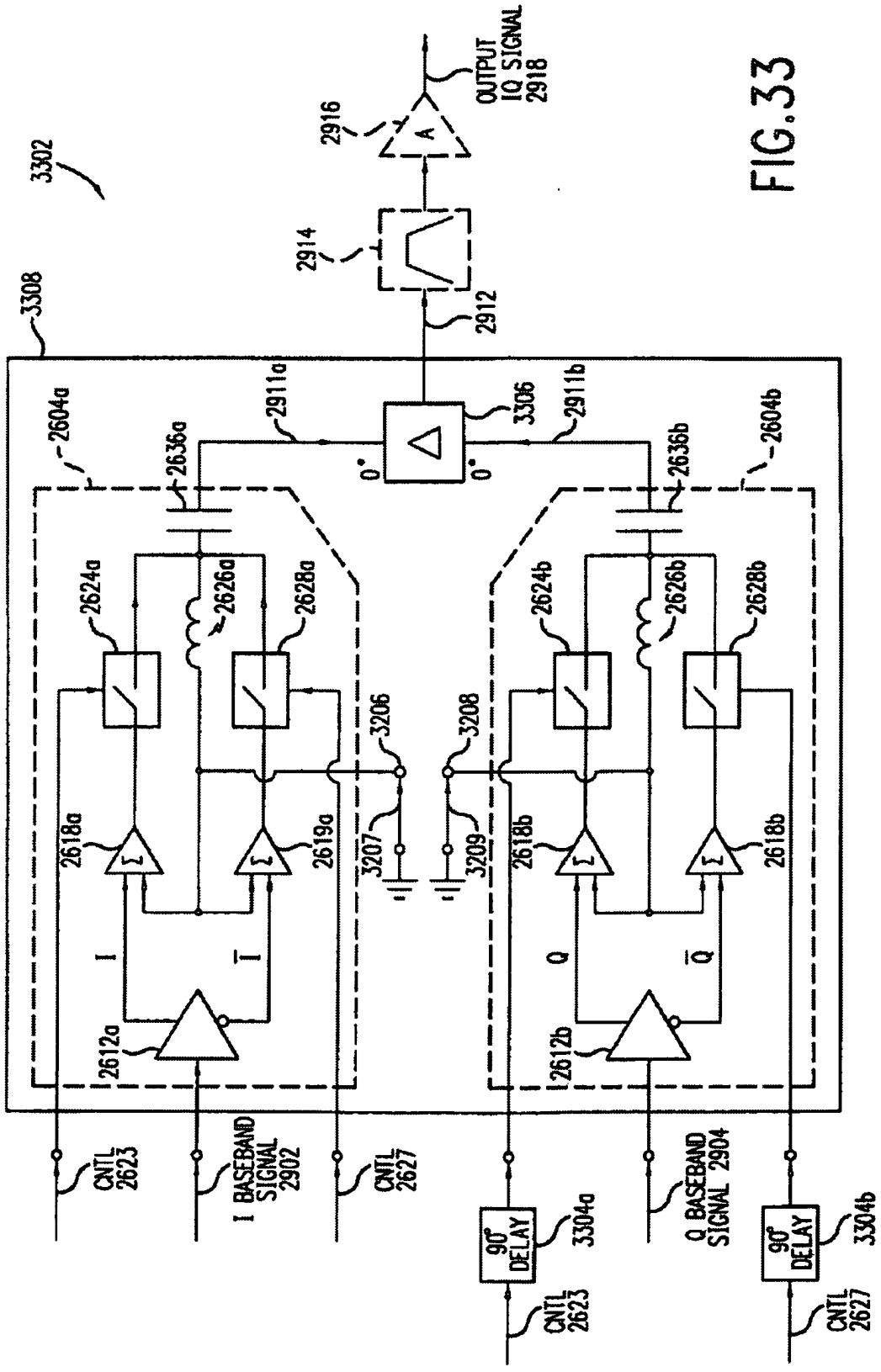

3302
3308
2916
OUTPUT IQ SIGNAL 2918
2914
2912
2911a
2911b
3306
0°
0°
2604a
2604b
2636a
2636b
2624a
2626a
2628a
2624b
2626b
2628b
3206
3208
3207
3209
2618a
2619a
2618b
I
Ī
Q
Q̄
2612a
2612b
CNTL 2623
I BASEBAND SIGNAL 2902
CNTL 2627
90° DELAY
3304a
Q BASEBAND SIGNAL 2904
90° DELAY
3304b
CNTL 2623
CNTL 2627

FIG. 33

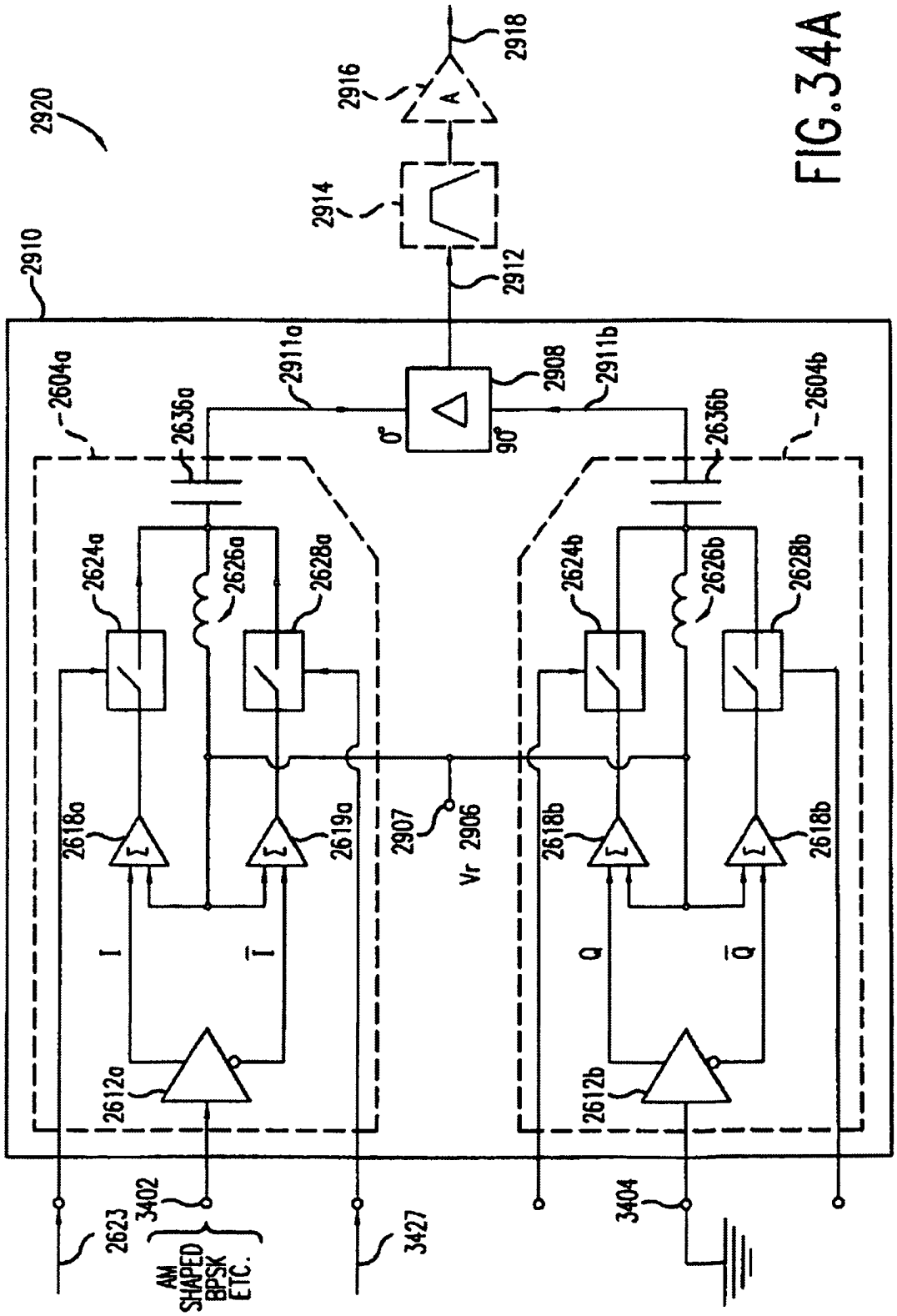

2920
2916
2918
2914
2912
2910
2911a
2908
2911b
2604a
2636a
0°
90°
2636b
2604b
2624a
2626a
2628a
2624b
2626b
2628b
2618a
2619a
2907
Vr 2906
2618b
2618b
I
Ī
Q
Q̄
2612a
2612b
2623
3402
AM SHAPED BPSK ETC.
3427
3404

FIG.34A

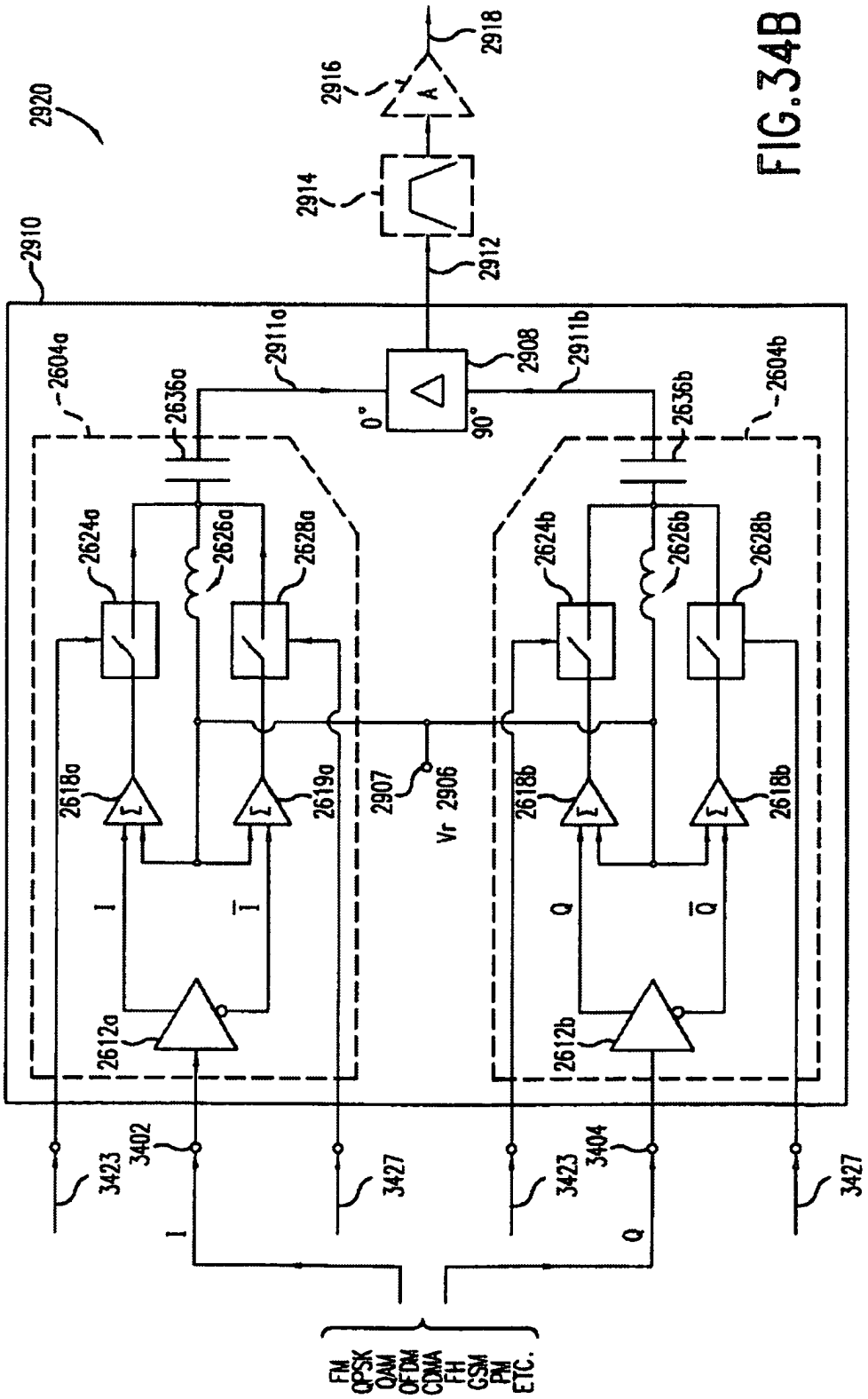

2920
2910
2916
2918
2914
2912
2911a
2908
2911b
2604a
2604b
2636a
2636b
0°
90°
2624a
2626a
2628a
2624b
2626b
2628b
2618a
2619a
2907
Vr 2906
2618b
I
Ī
Q
Q̄
2612a
2612b
3423
3402
3427
3404
FM
QPSK
QAM
OFDM
CDMA
FH
GSM
AM
ETC.

FIG.34B

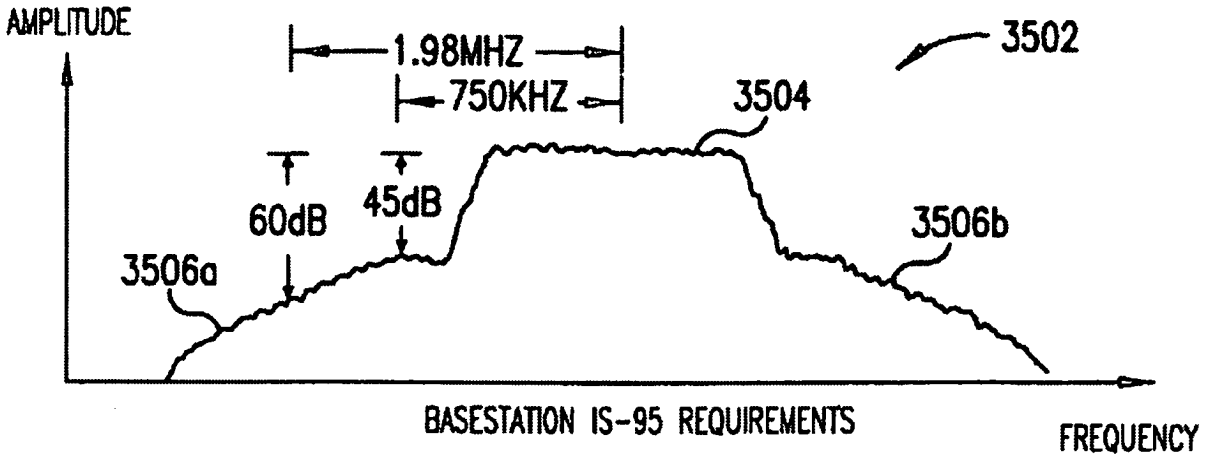


FIG.35A

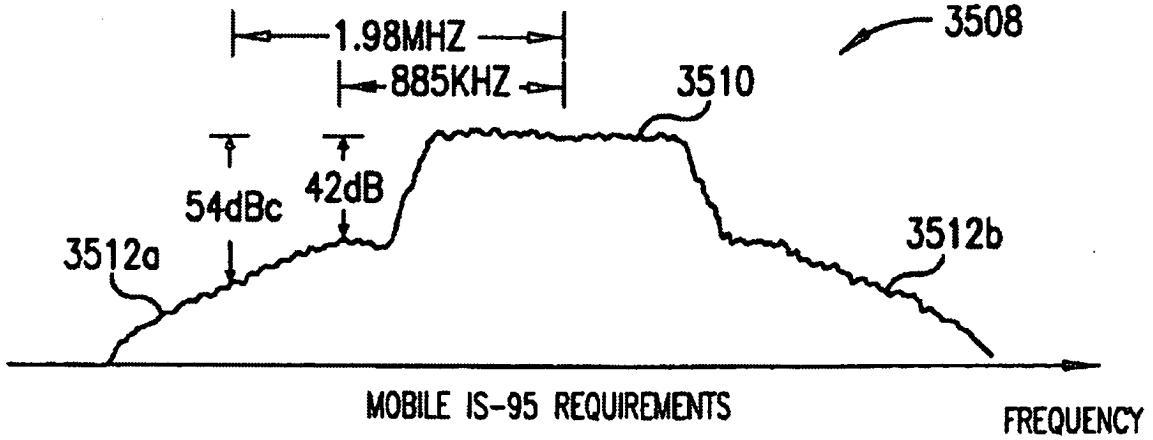


FIG.35B

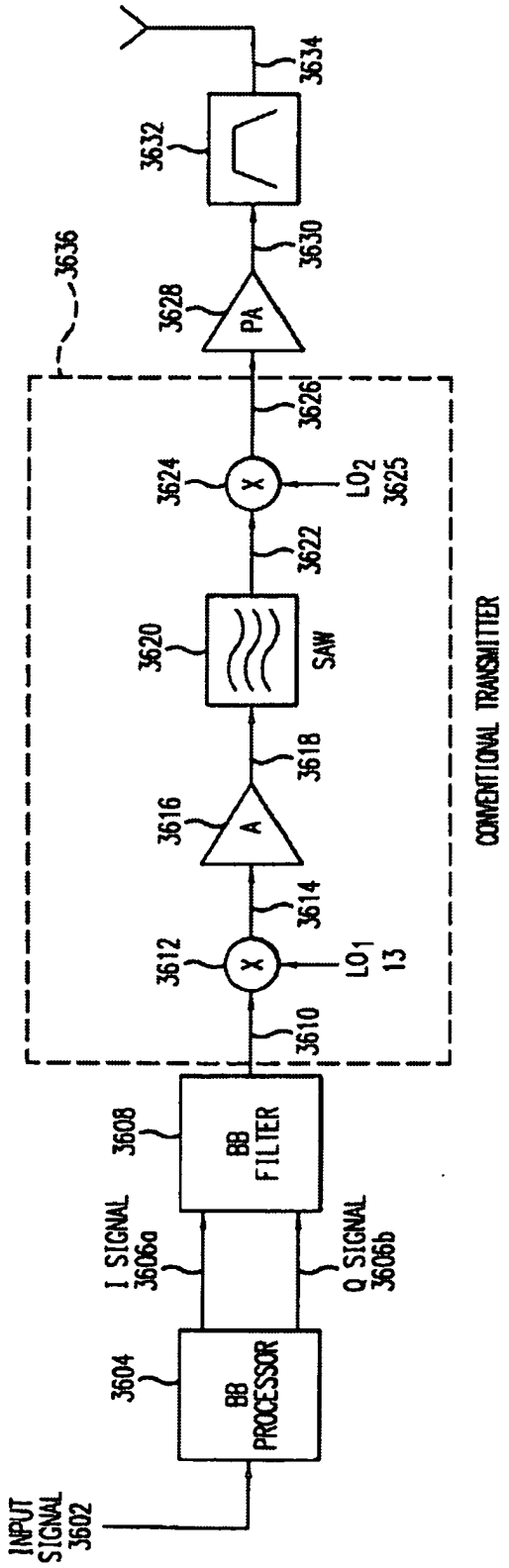

3600
3636
3634
3632
3630
3628
PA
3626
3624
X
LO2
3625
3622
3620
SAW
3618
3616
A
3614
3612
X
LO1
13
3610
CONVENTIONAL TRANSMITTER
3608
BB FILTER
I SIGNAL 3606a
Q SIGNAL 3606b
3604
BB PROCESSOR
INPUT SIGNAL 3602

FIG. 36

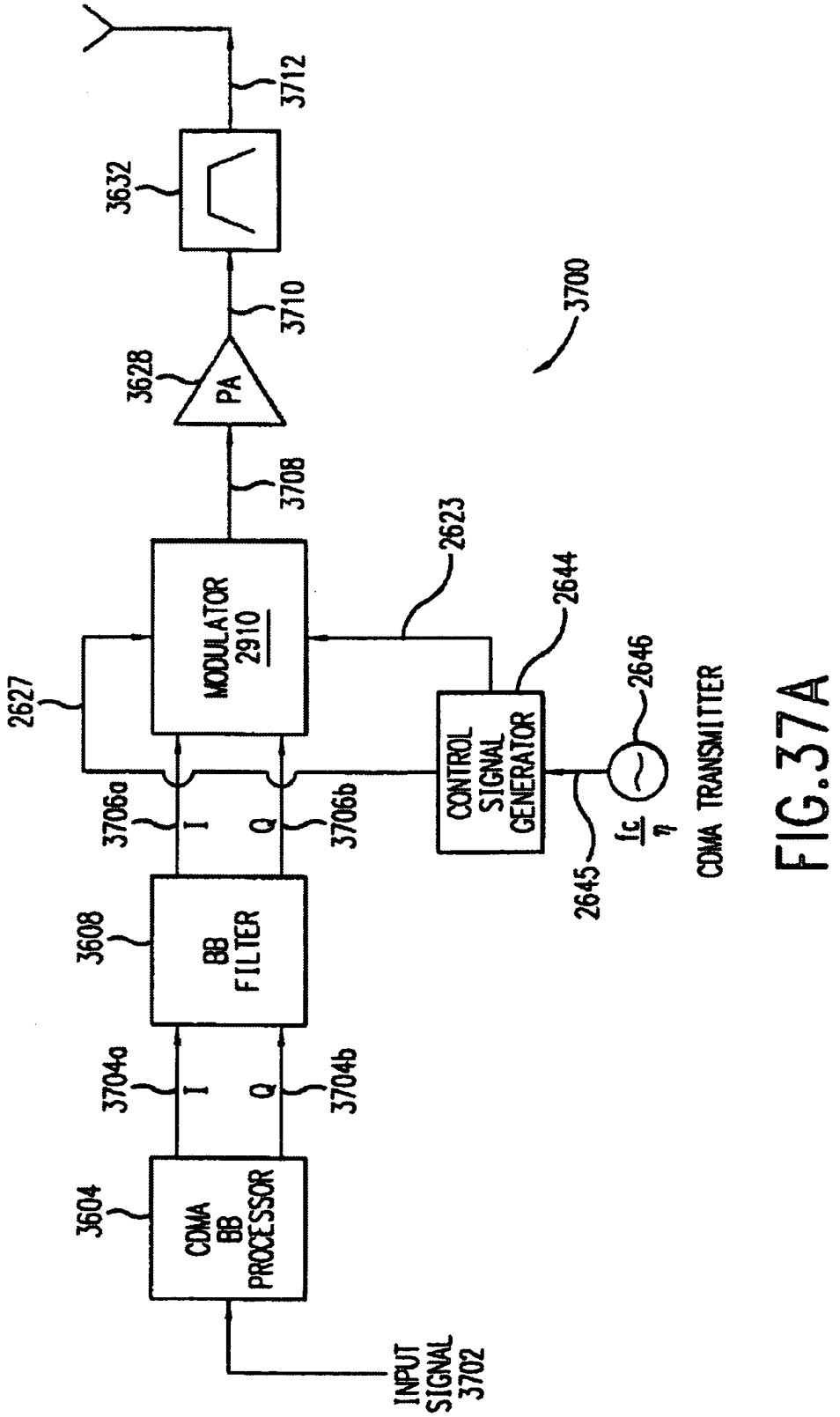

3712
3632
3710
3700
3628
PA
3708
2623
2644
MODULATOR
2910
2627
2646
3706a
I
Q
3706b
CONTROL
SIGNAL
GENERATOR
fc
η
2645
CDMA TRANSMITTER
3608
BB
FILTER
3704a
I
Q
3704b
3604
CDMA
BB
PROCESSOR
INPUT
SIGNAL
3702

FIG.37A

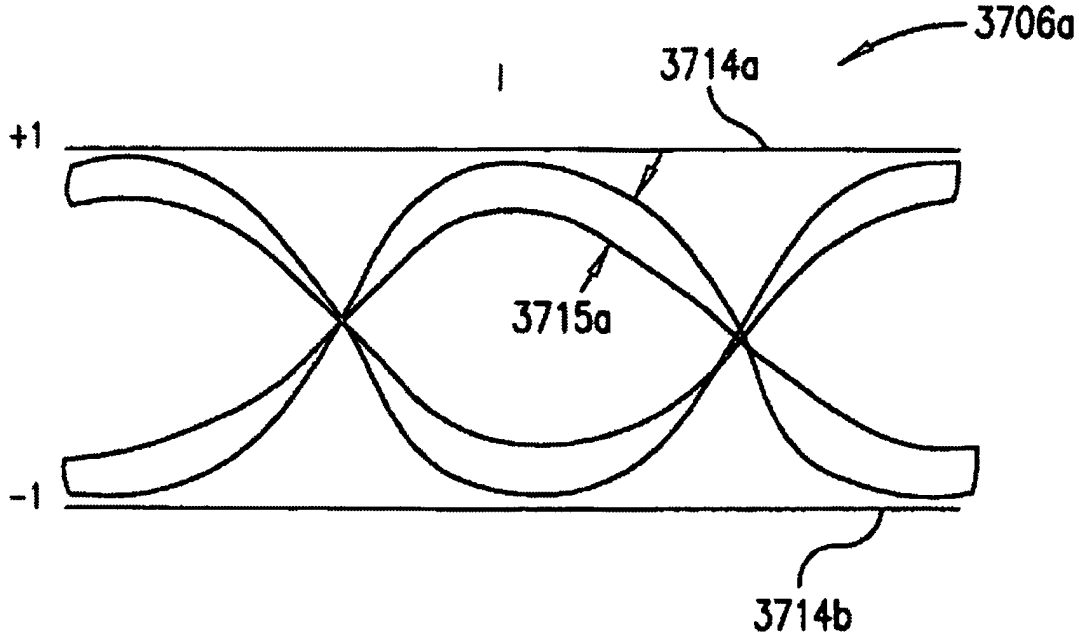


FIG.37B

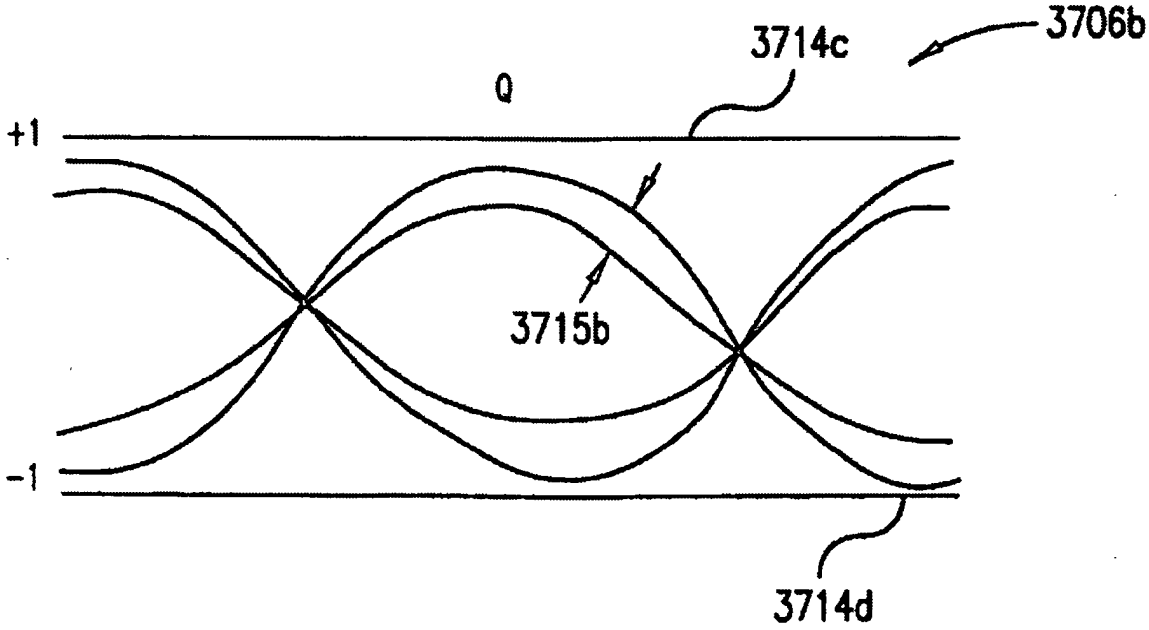


FIG.37C

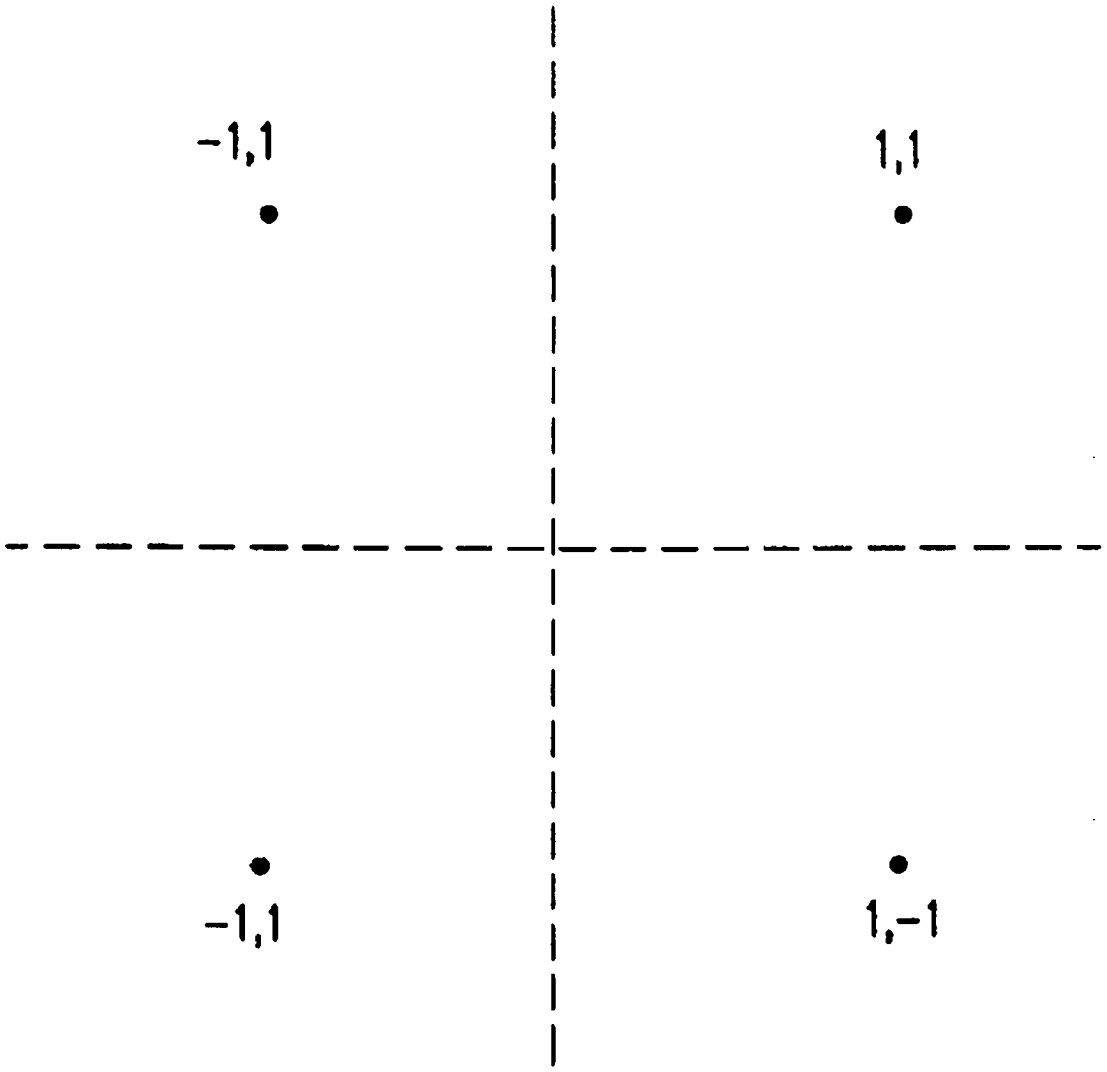


FIG.37D

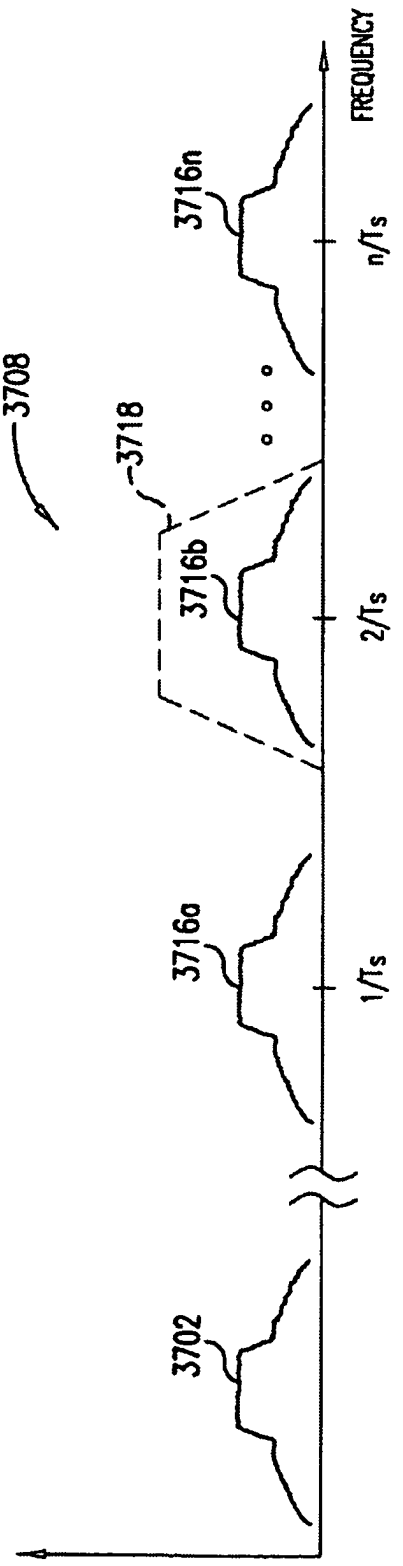


FIG.37E

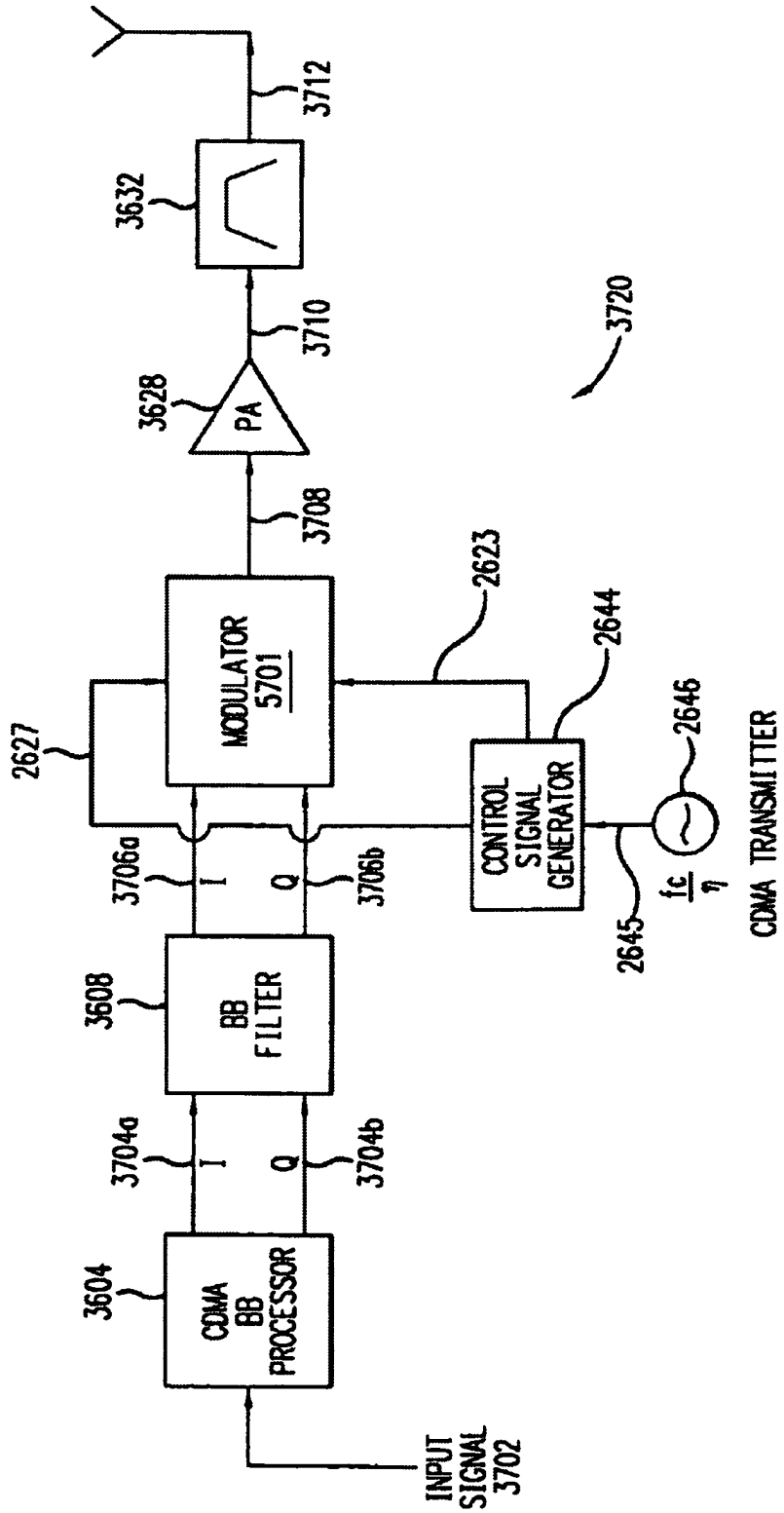

3712
3632
3710
3628
PA
3708
3720
2623
2644
2646
MODULATOR 5701
2627
3706a
I
Q
3706b
CONTROL SIGNAL GENERATOR
2645
fc/η
CDMA TRANSMITTER
3608
BB FILTER
3704a
I
Q
3704b
3604
CDMA BB PROCESSOR
INPUT SIGNAL 3702

FIG.37F

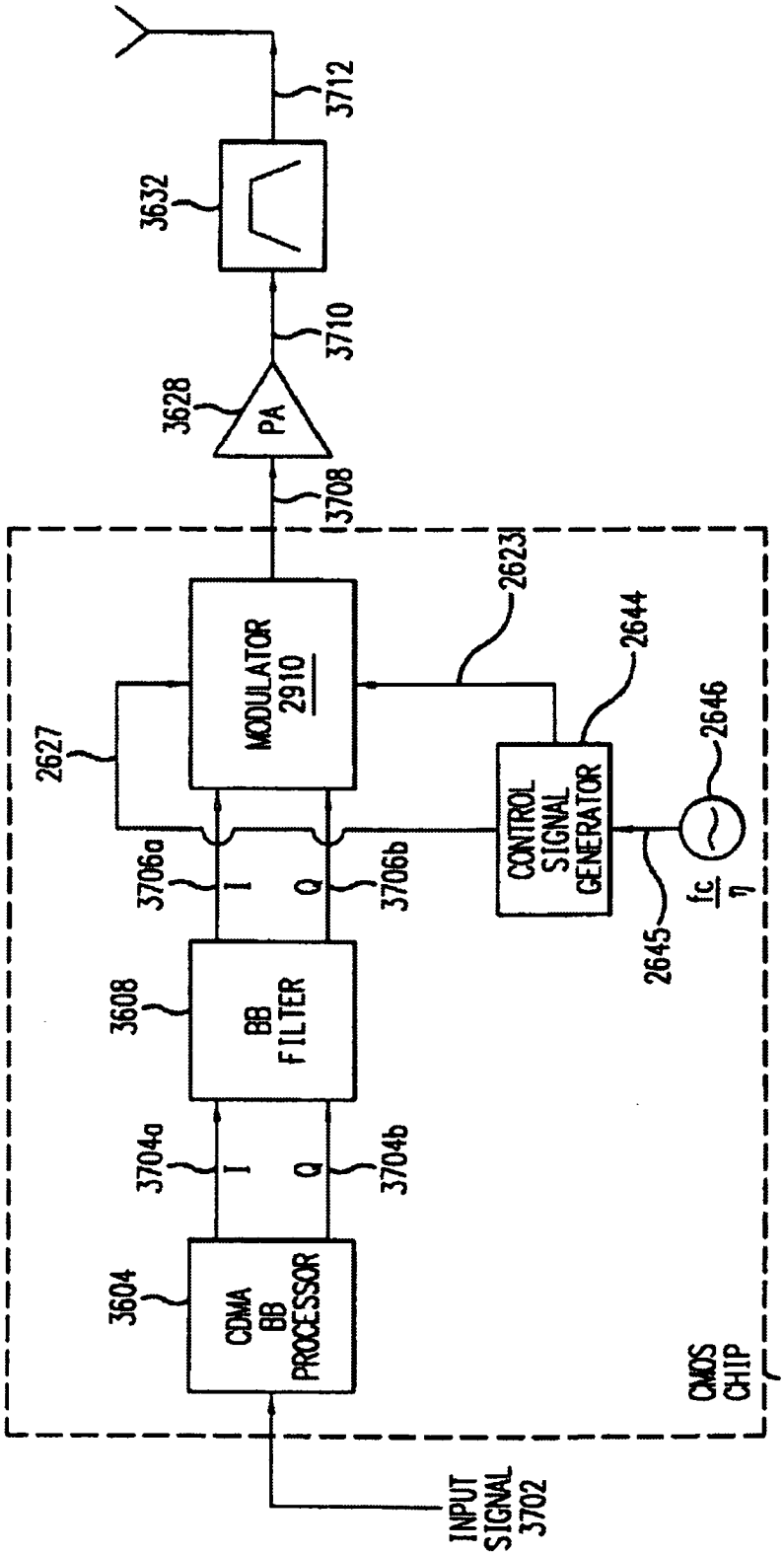

3712
3632
3710
3628
PA
3708
MODULATOR 2910
2623
2644
2627
2646
CONTROL SIGNAL GENERATOR
3706a
I
Q
3706b
fc/η
2645
3608
BB FILTER
3704a
I
Q
3704b
3604
CDMA BB PROCESSOR
CMOS CHIP
3802
CDMA CMOS CHIP
INPUT SIGNAL 3702

FIG. 38

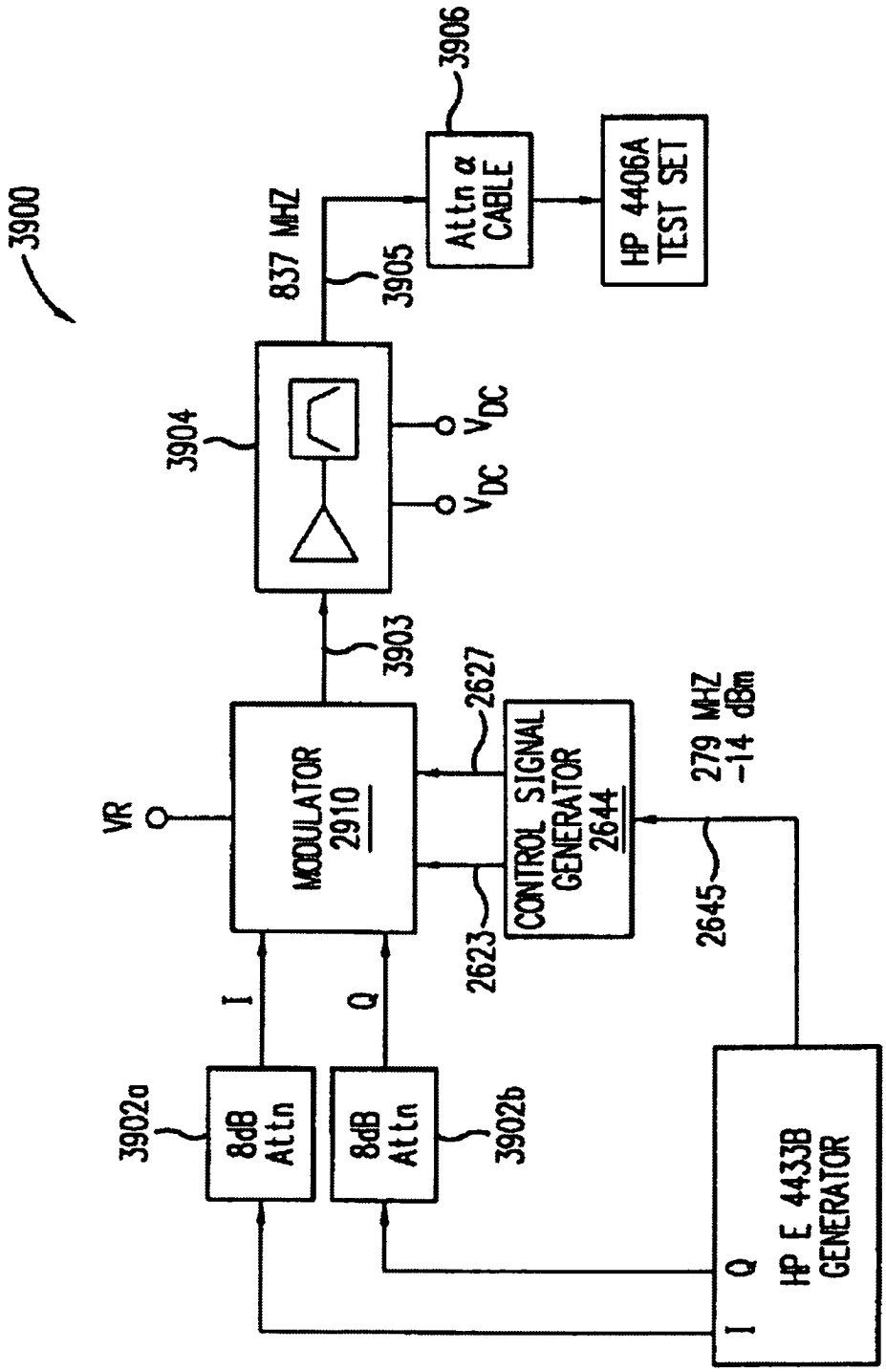

3900
3906
Attn α CABLE
HP 4406A TEST SET
837 MHZ
3905
3904
V_{DC}
V_{DC}
3903
2627
CONTROL SIGNAL GENERATOR 2644
279 MHZ -14 dBm
2645
2623
VR
MODULATOR 2910
I
Q
3902a
8dB Attn
8dB Attn
3902b
HP E 4433B GENERATOR
I Q

FIG. 39

4002

BASE STATION

RHO	0.9970
EVM	5.51%
PHASE ERROR	1.80°
MAGNITUDE ERROR	4.53%
CARRIER INSERTION	-37.91 dB
PA POWER OUT	28.06 dBm

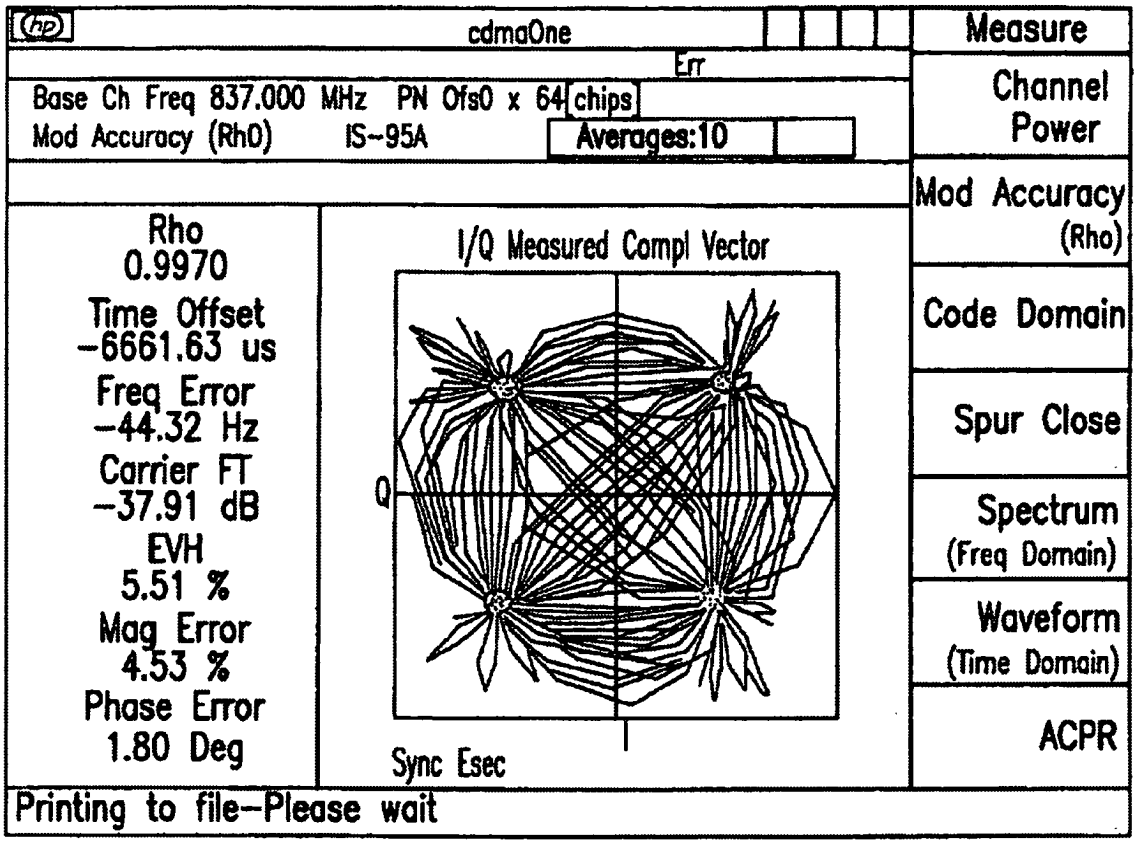
FIG.40

FREQUENCY (MHz) (MOBILE STATION)

4102

	LOW	MIDDLE	HIGH
RHO	0.9892	0.9969	0.9892
EVM	10.39%	5.54%	10.39%
PHASE ERROR	4.47°	2.24°	4.08°
MAGNITUDE ERROR	6.84%	4.21%	8.27%
CARRIER INSERTION	-40.15 dB	-44.58 dB	-35.27 dB
PA POWER OUT	27.36 dBm	28.11 dBm	27.55 dBm

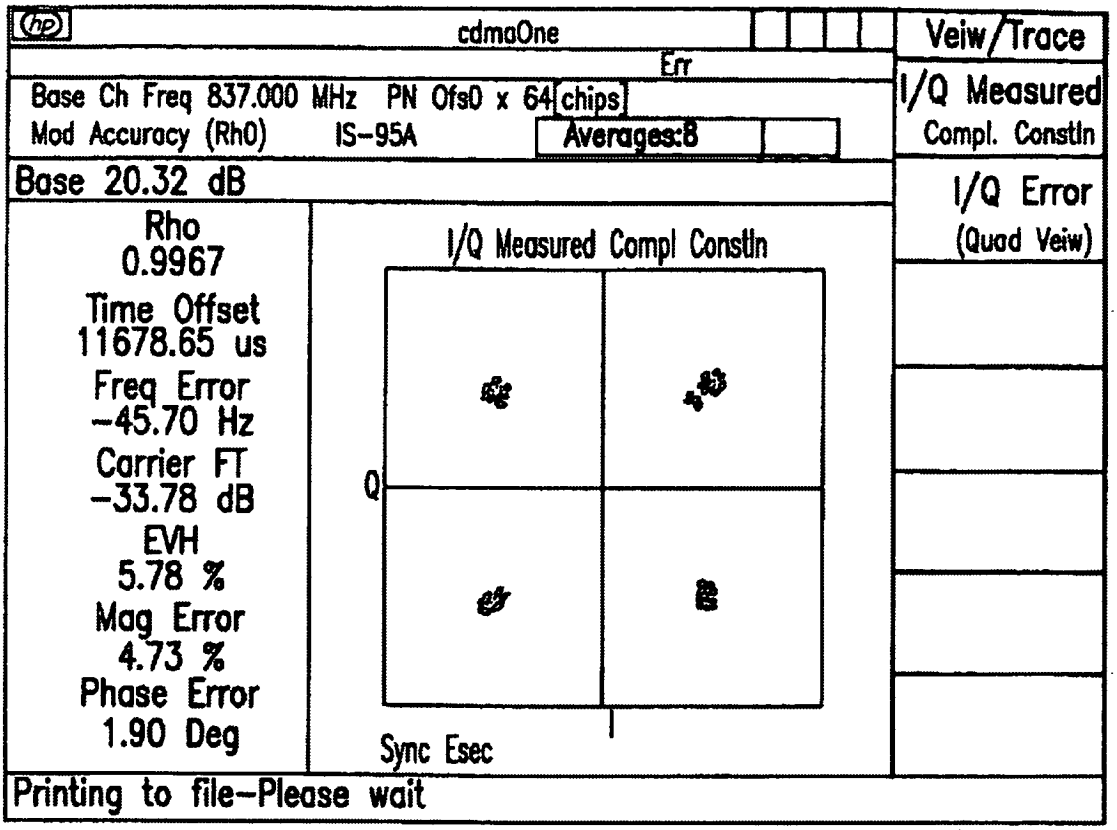
FIG.41



BASE STATION CONSTELLATION FOR PILOT CHANNEL TEST

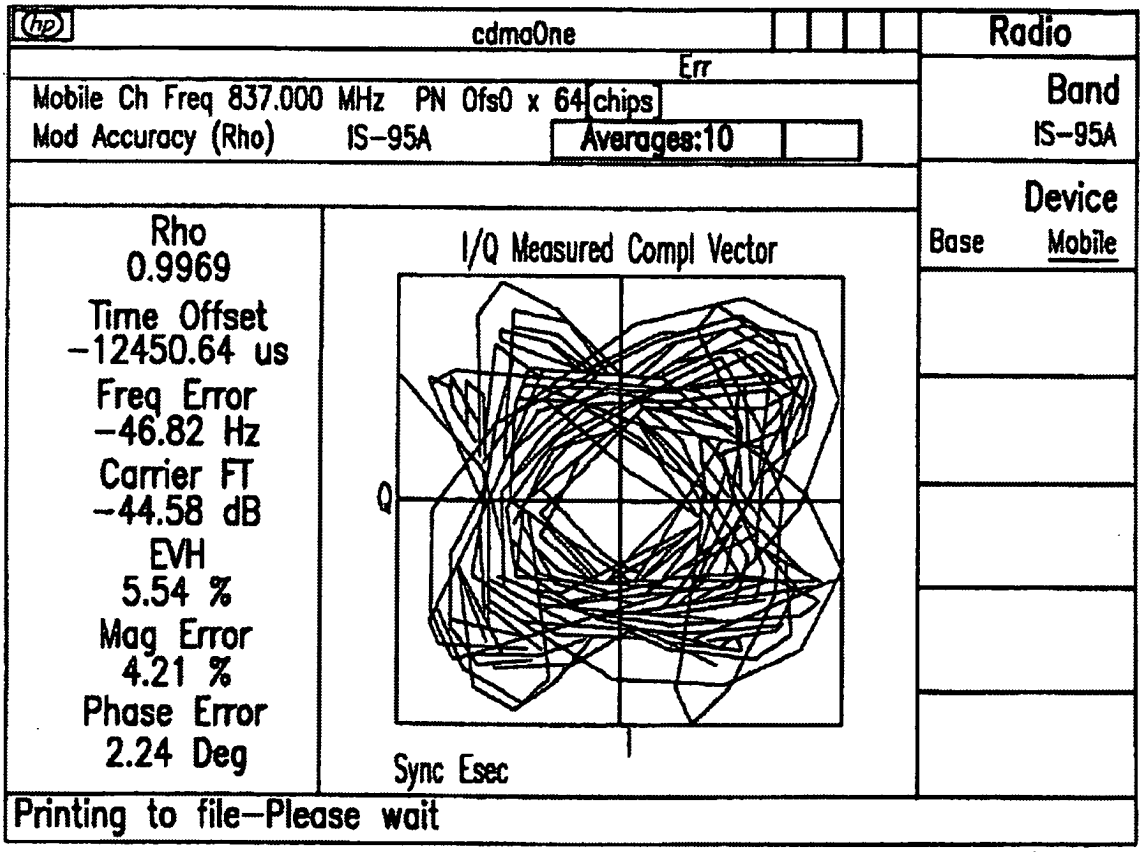
FIG.42

4202



BASE STATION SAMPLED CONSTELLATION

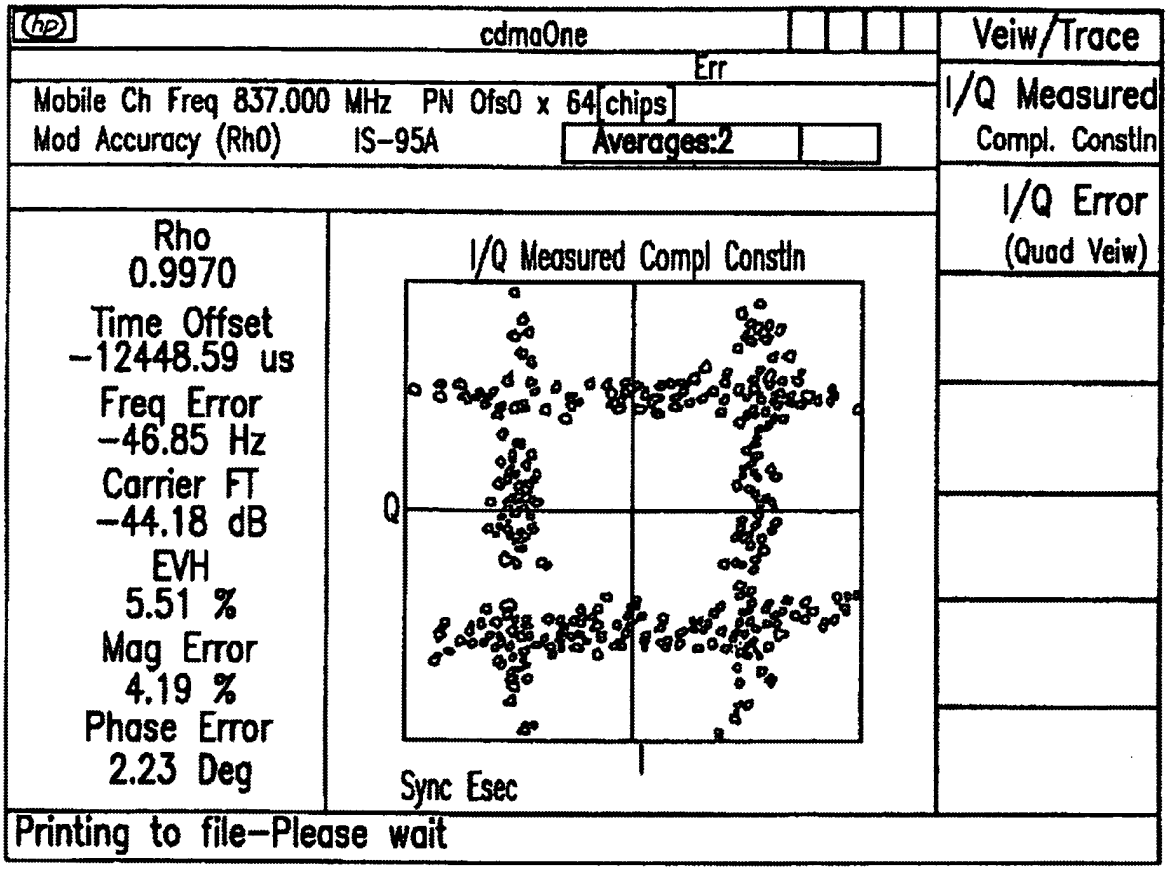
FIG.43



MOBILE STATION CONSTELLATION FOR ACCESS CHANNEL TEST

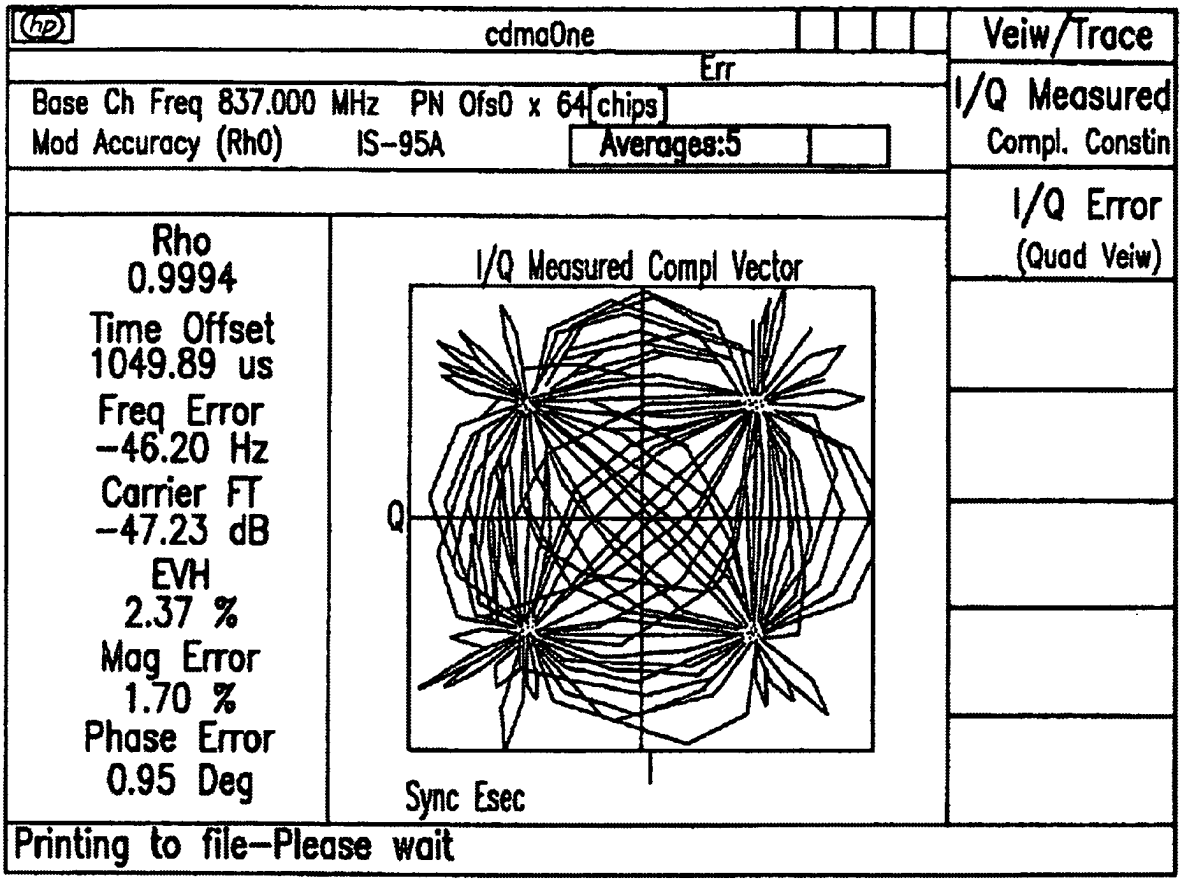
FIG.44

4402



MOBILE STATION SAMPLED CONSTELLATION

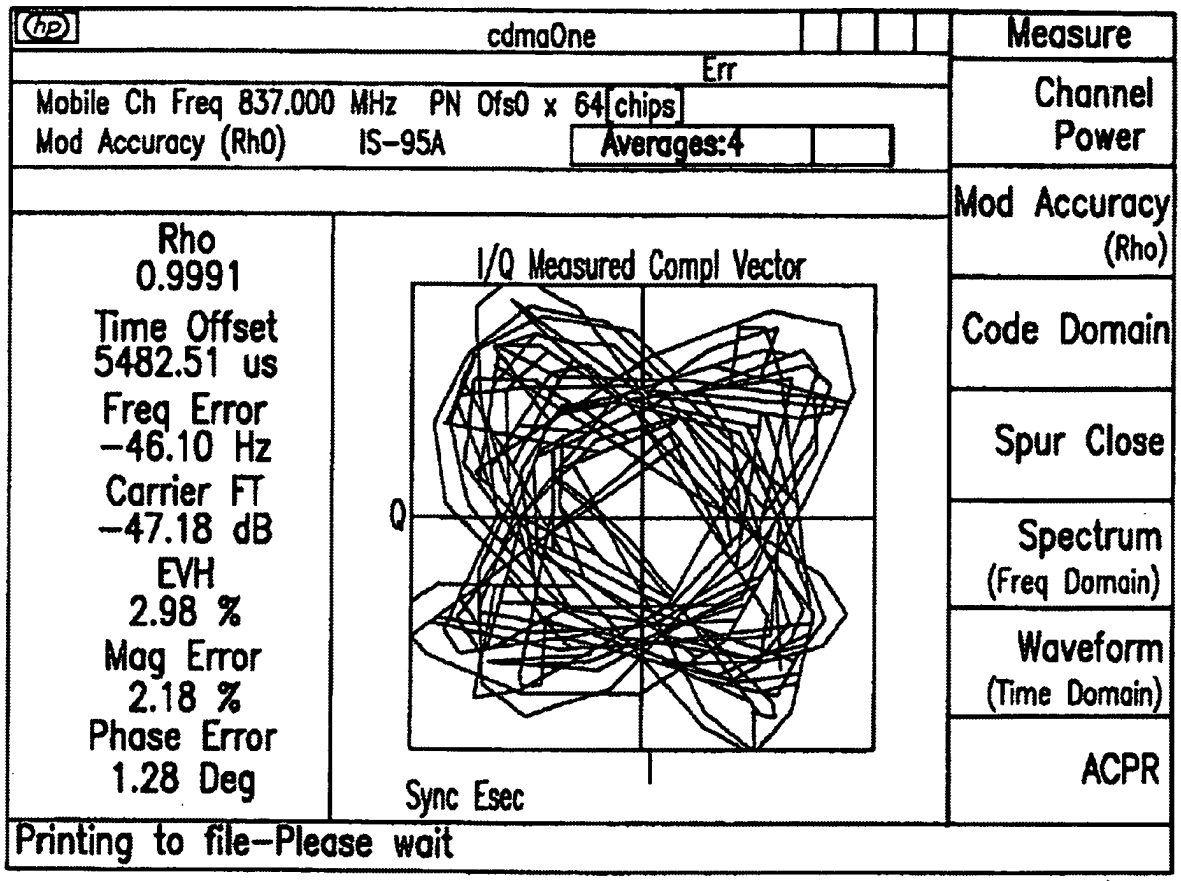
FIG.45



BASE STATION CONSTELLATION USING ONLY H/P TEST EQUIPMENT

FIG.46

4602



MOBILE CONSTELLATION USING ONLY H/P TEST EQUIPMENT

FIG.47

4702

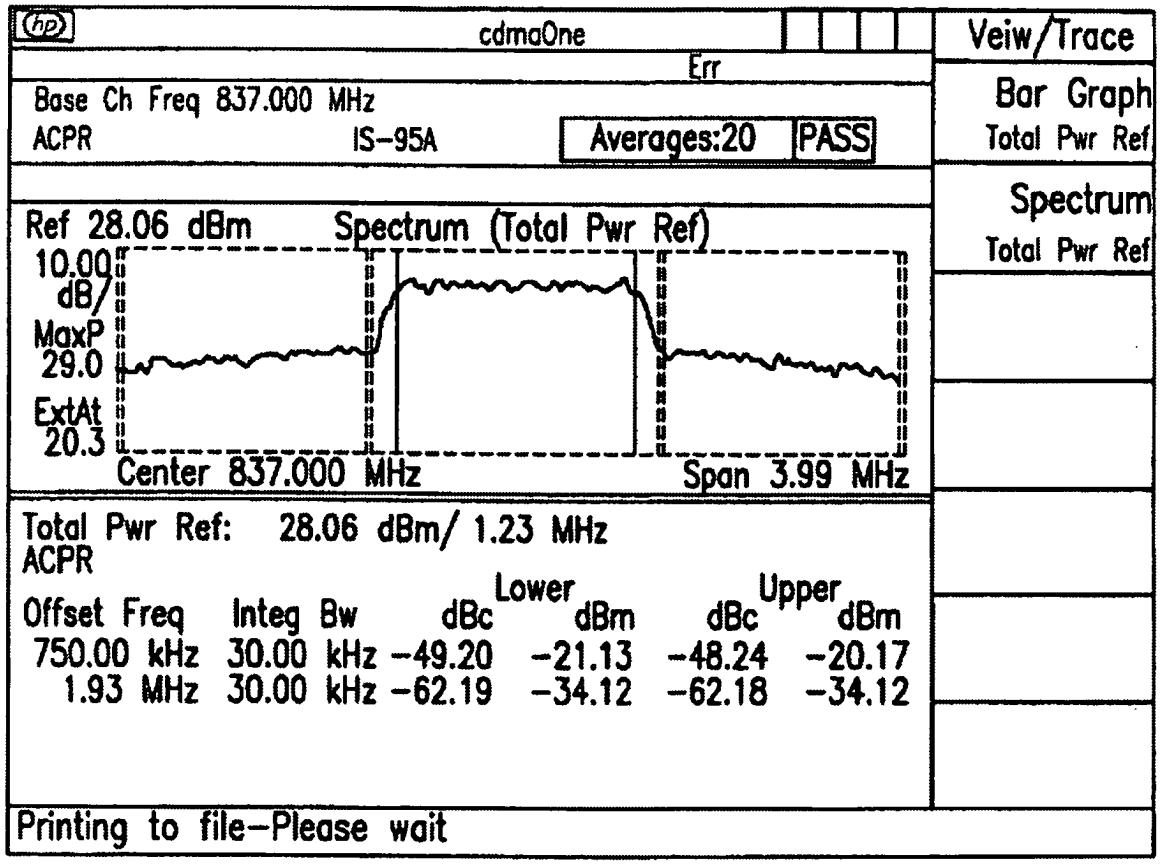
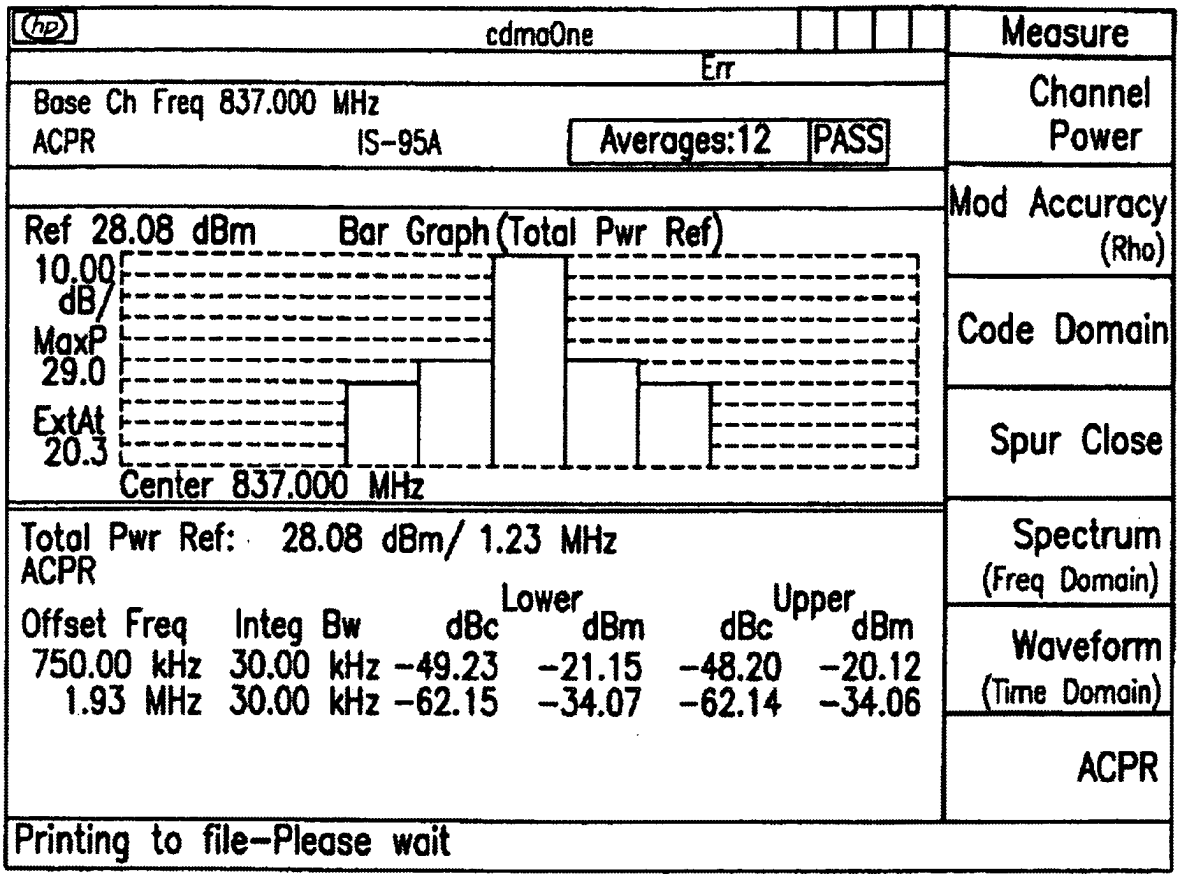

cdmaOne
Err
Veiw/Trace
Base Ch Freq 837.000 MHz
ACPR
IS-95A
Averages:20
PASS
Bar Graph
Total Pwr Ref
Spectrum
Total Pwr Ref
Ref 28.06 dBm
Spectrum (Total Pwr Ref)
10.00 dB/
MaxP 29.0
ExtAt 20.3
Center 837.000 MHz
Span 3.99 MHz
Total Pwr Ref: 28.06 dBm/ 1.23 MHz
ACPR
Lower
Upper
Offset Freq Integ Bw dBc dBm dBc dBm
750.00 kHz 30.00 kHz -49.20 -21.13 -48.24 -20.17
1.93 MHz 30.00 kHz -62.19 -34.12 -62.18 -34.12
Printing to file-Please wait

FIG. 48

4802



BASE STATION SPECTRAL RESPONSE WITH MASK

FIG.49

4902

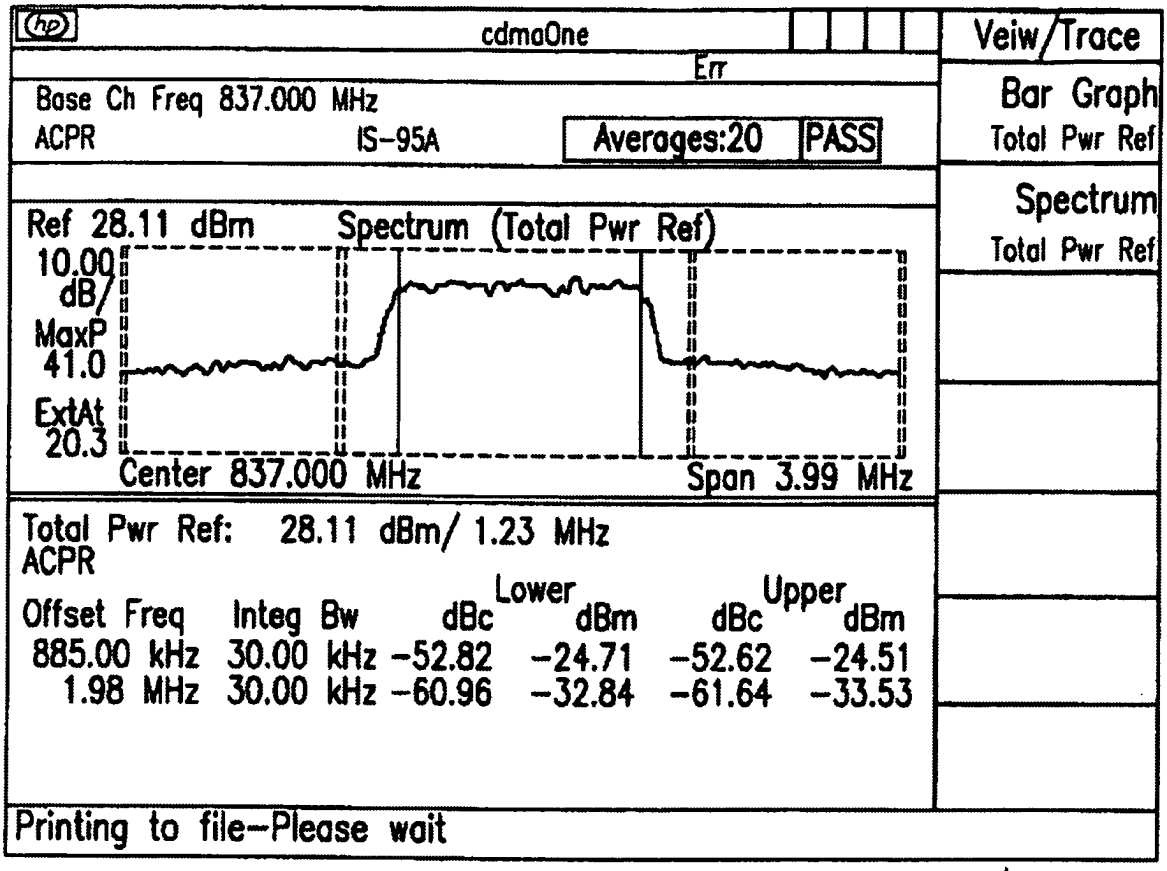
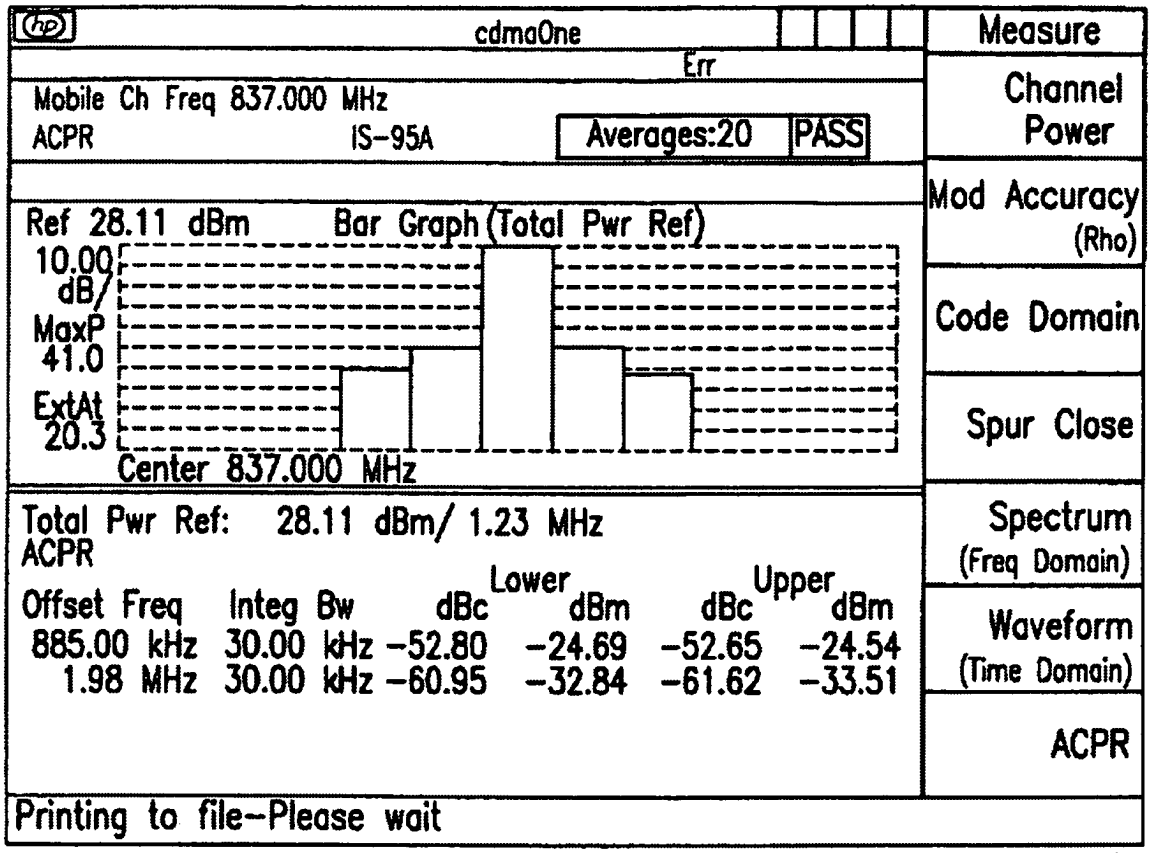

cdmaOne
Err
Veiw/Trace
Base Ch Freq 837.000 MHz
ACPR
IS-95A
Averages:20
PASS
Bar Graph
Total Pwr Ref
Ref 28.11 dBm
Spectrum (Total Pwr Ref)
Spectrum
Total Pwr Ref
10.00
dB/
MaxP
41.0
ExtAt
20.3
Center 837.000 MHz
Span 3.99 MHz
Total Pwr Ref: 28.11 dBm/ 1.23 MHz
ACPR
Lower
Upper
Offset Freq Integ Bw dBc dBm dBc dBm
885.00 kHz 30.00 kHz -52.82 -24.71 -52.62 -24.51
1.98 MHz 30.00 kHz -60.96 -32.84 -61.64 -33.53
Printing to file--Please wait
5002

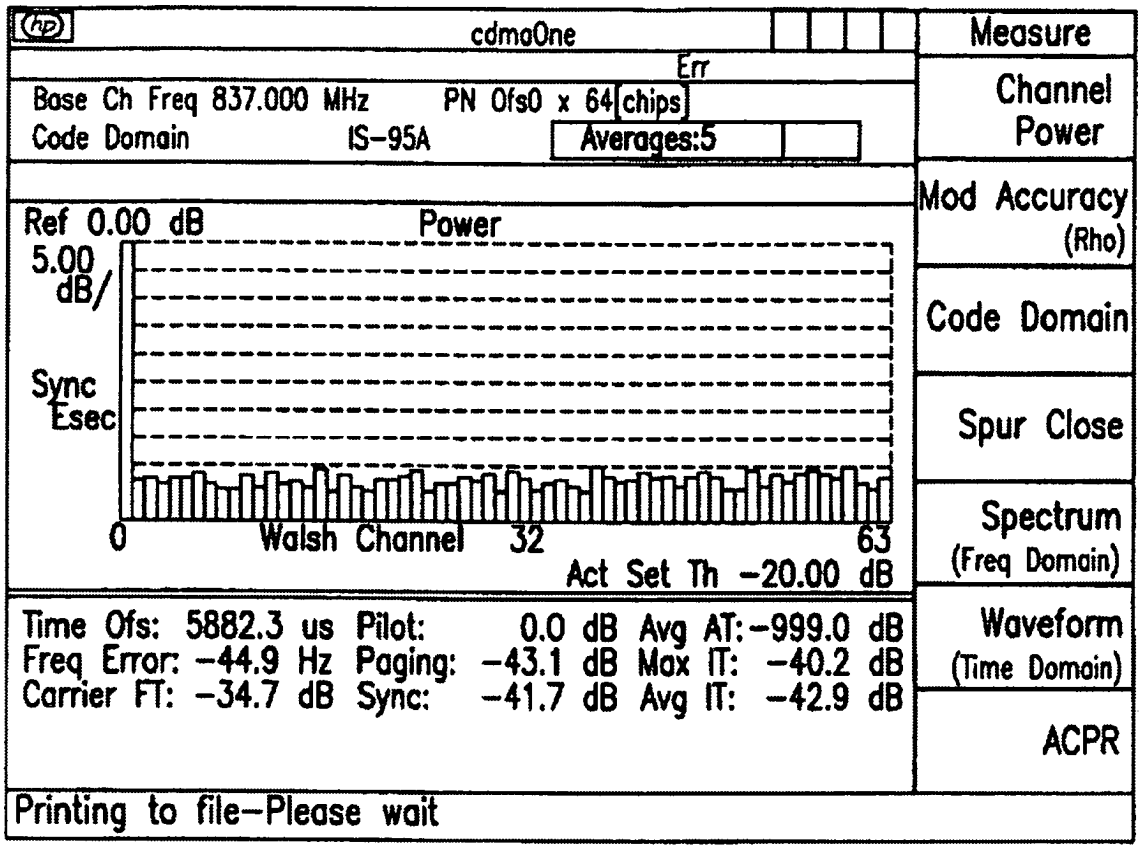
FIG.50



MOBILE STATION SPECTRAL RESPONSE WITH MASK

FIG.51

5102



CDMA CROSSTALK

FIG.52A

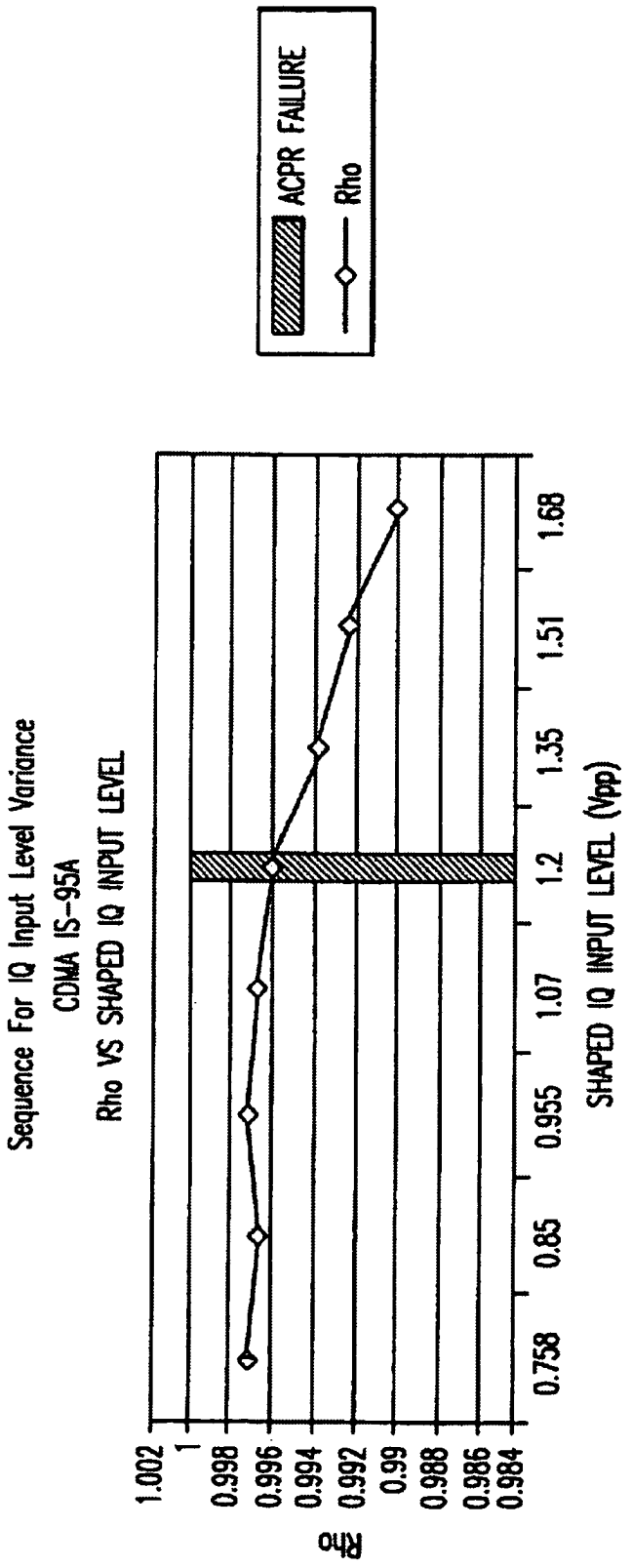

ACPR FAILURE
Rho
Sequence For IQ Input Level Variance
CDMA IS-95A
Rho VS SHAPED IQ INPUT LEVEL
Rho
1.002
1
0.998
0.996
0.994
0.992
0.99
0.988
0.986
0.984
0.758
0.85
0.955
1.07
1.2
1.35
1.51
1.68
SHAPED IQ INPUT LEVEL (Vpp)

FIG.52B

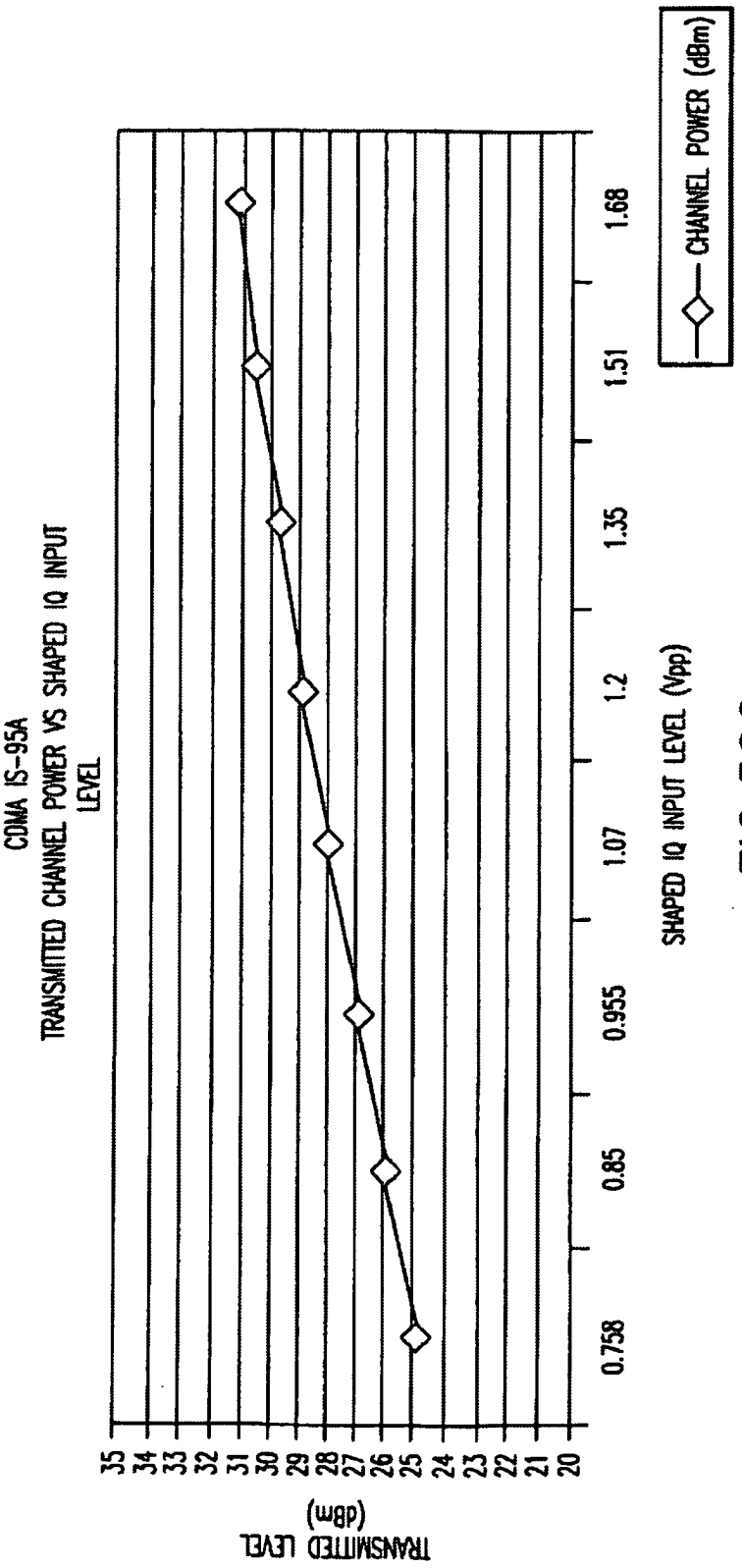

CDMA IS-95A
TRANSMITTED CHANNEL POWER VS SHAPED IQ INPUT LEVEL
CHANNEL POWER (dBm)
TRANSMITTED LEVEL (dBm)
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
0.758
0.85
0.955
1.07
1.2
1.35
1.51
1.68
SHAPED IQ INPUT LEVEL (Vpp)

FIG.52C

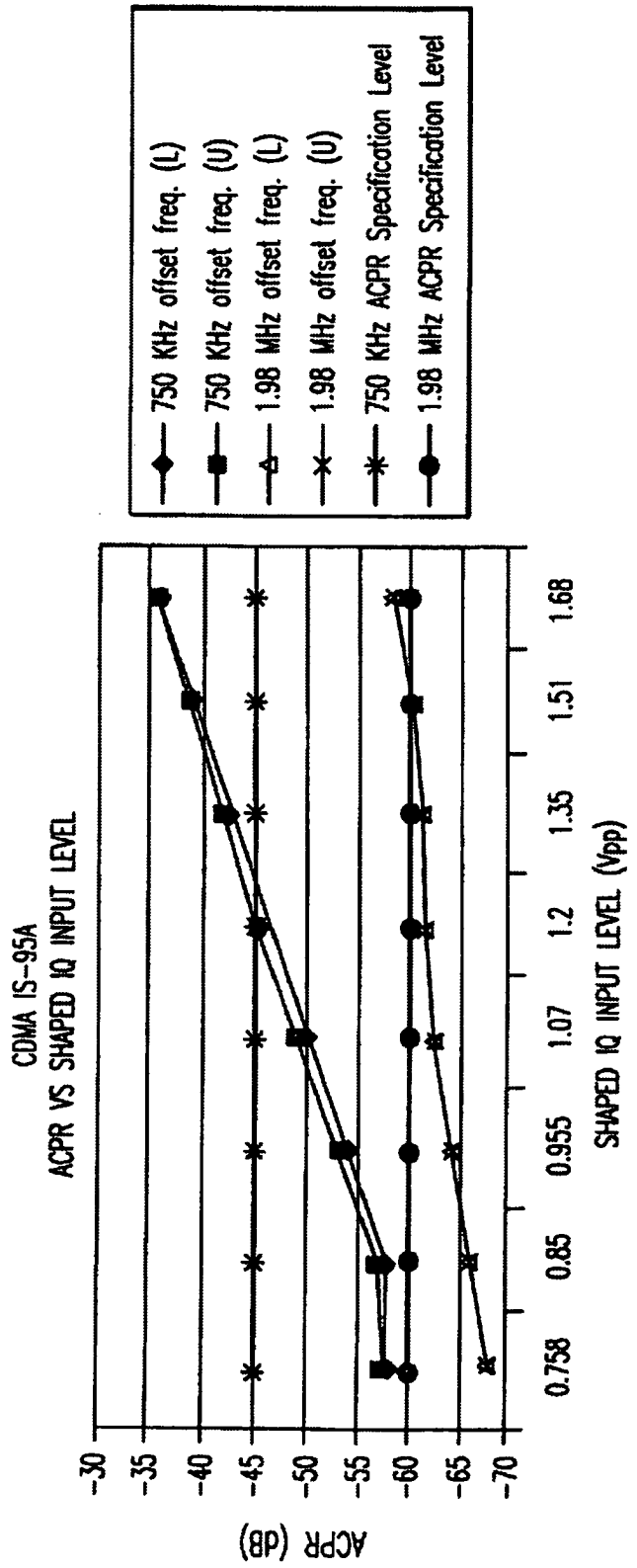

750 KHz offset freq. (L)
750 KHz offset freq. (U)
1.98 MHz offset freq. (L)
1.98 MHz offset freq. (U)
750 KHz ACPR Specification Level
1.98 MHz ACPR Specification Level
CDMA IS-95A
ACPR VS SHAPED IQ INPUT LEVEL
ACPR (dB)
-30
-35
-40
-45
-50
-55
-60
-65
-70
0.758
0.85
0.955
1.07
1.2
1.35
1.51
1.68
SHAPED IQ INPUT LEVEL (Vpp)

FIG.52D

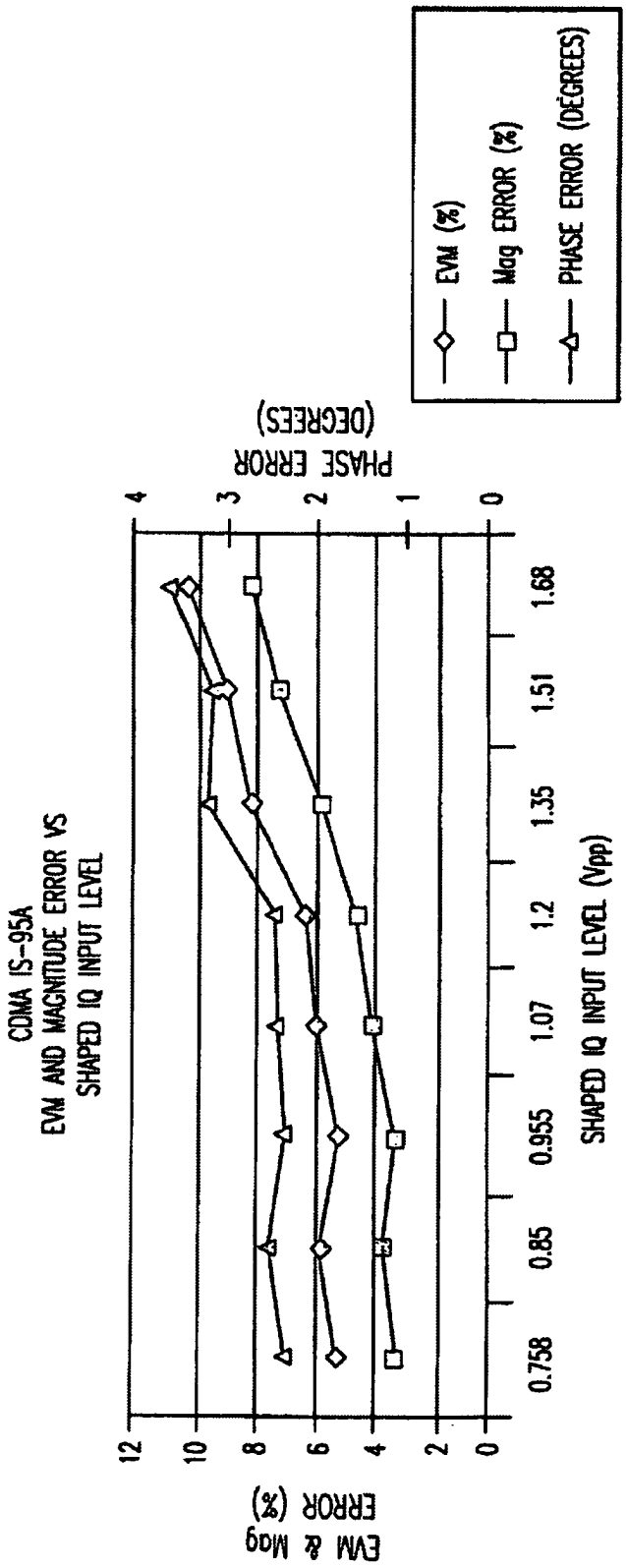

CDMA IS-95A
EVM AND MAGNITUDE ERROR VS
SHAPED IQ INPUT LEVEL
EVM & Mag ERROR (%)
PHASE ERROR (DEGREES)
SHAPED IQ INPUT LEVEL (Vpp)
0.758
0.85
0.955
1.07
1.2
1.35
1.51
1.68
0
2
4
6
8
10
12
0
1
2
3
4
EVM (%)
Mag ERROR (%)
PHASE ERROR (DEGREES)

FIG.52E

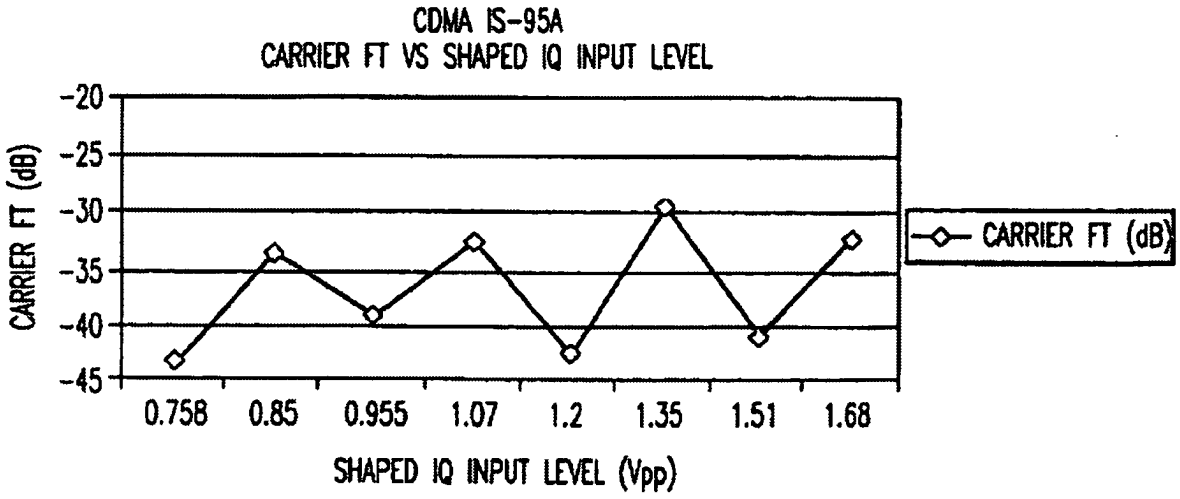


FIG.52F

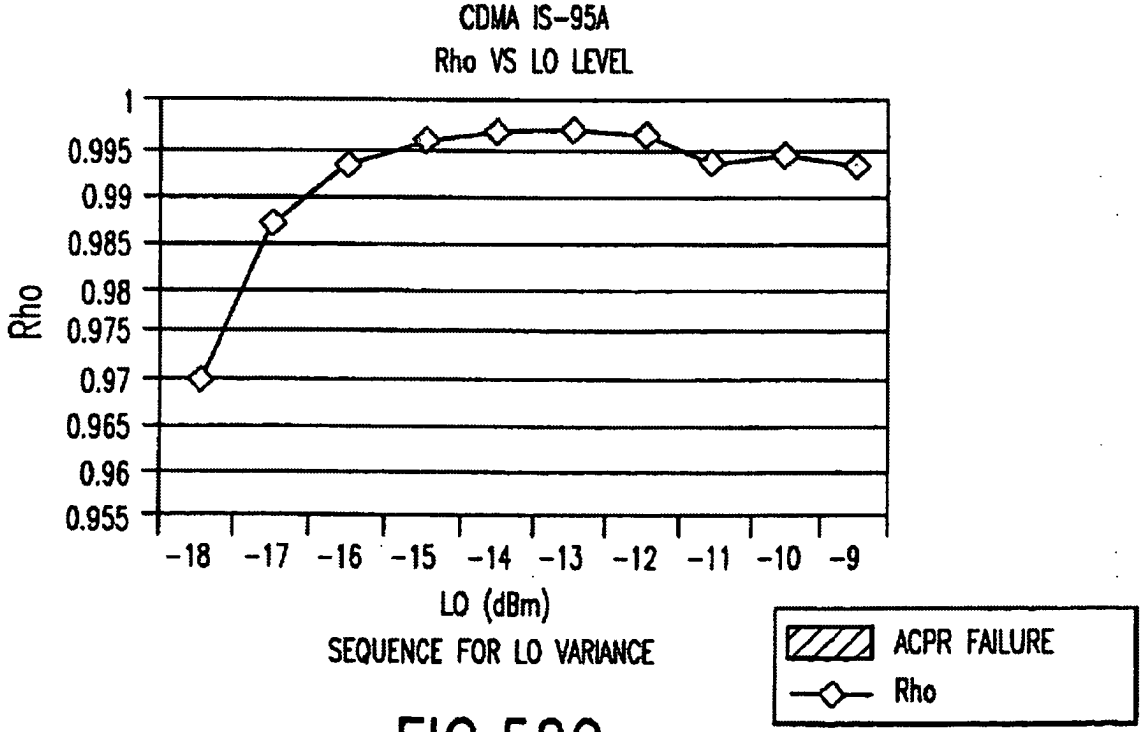


FIG.52G

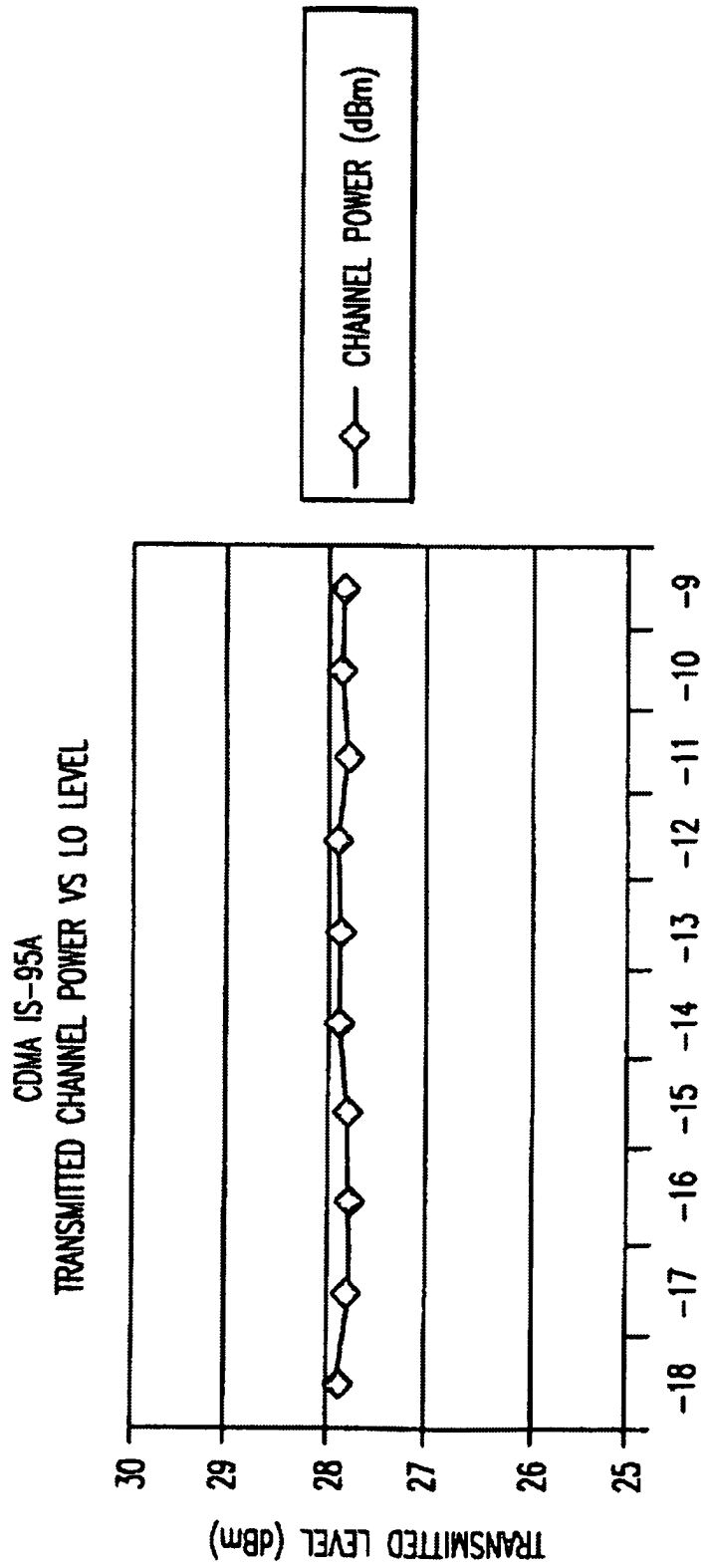

CHANNEL POWER (dBm)
CDMA IS-95A
TRANSMITTED CHANNEL POWER VS LO LEVEL
TRANSMITTED LEVEL (dBm)
30
29
28
27
26
25
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
LO (dBm)

FIG.52H

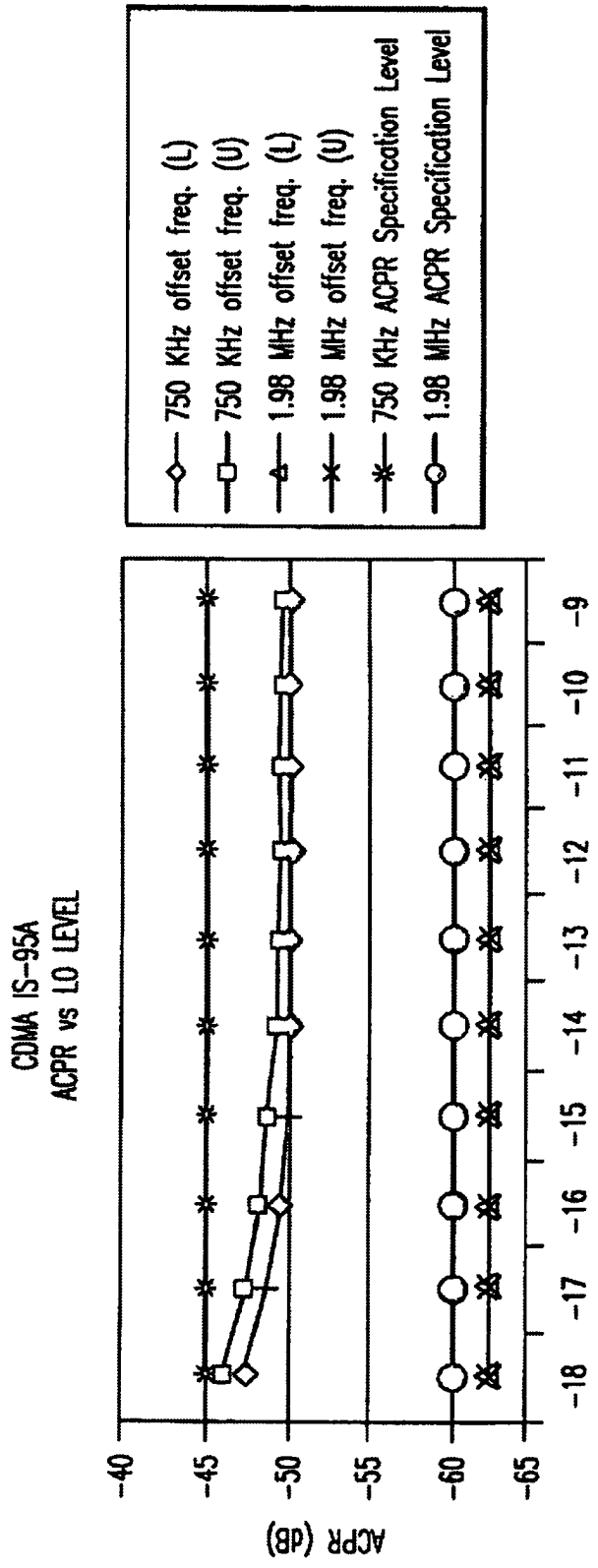

CDMA IS-95A
ACPR vs LO LEVEL
750 KHz offset freq. (L)
750 KHz offset freq. (U)
1.98 MHz offset freq. (L)
1.98 MHz offset freq. (U)
750 KHz ACPR Specification Level
1.98 MHz ACPR Specification Level
ACPR (dB)
-40
-45
-50
-55
-60
-65
LO (dbm)
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18

FIG.52I

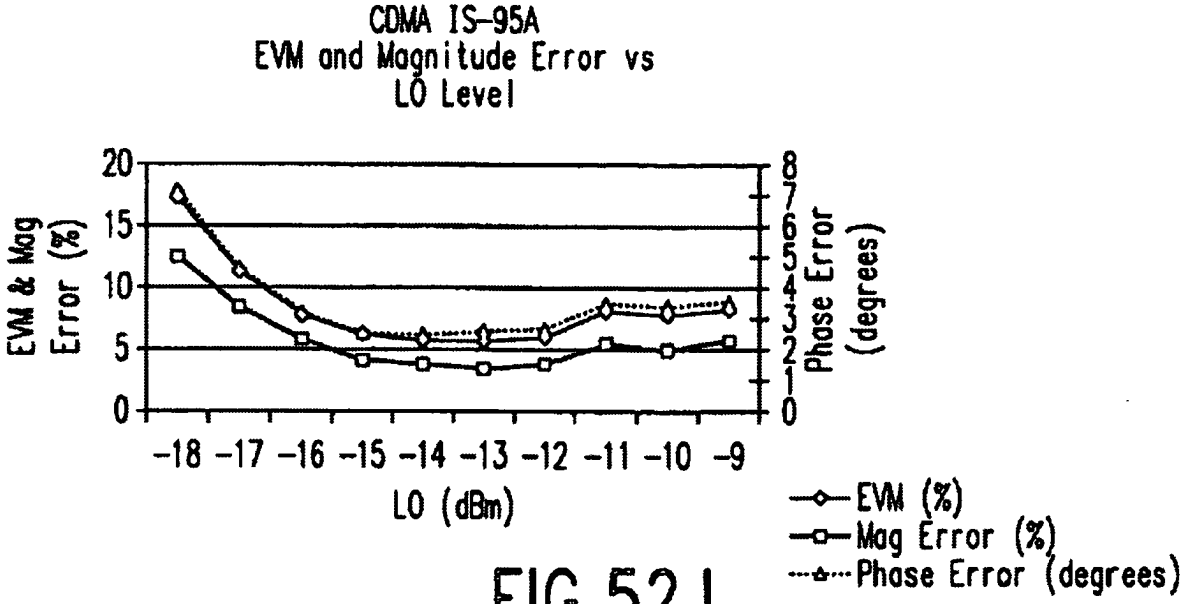


FIG.52J

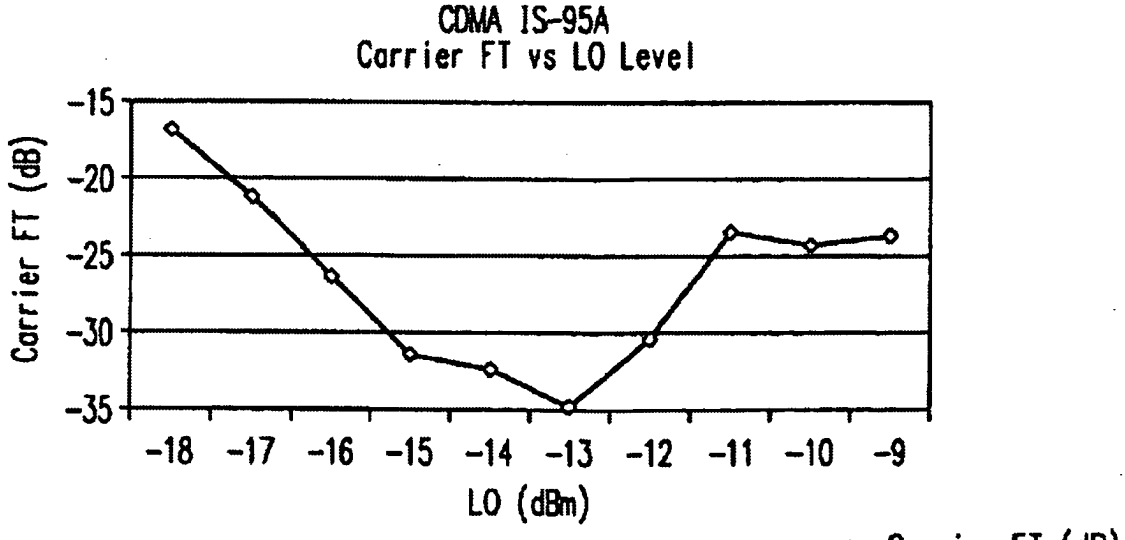


FIG.52K

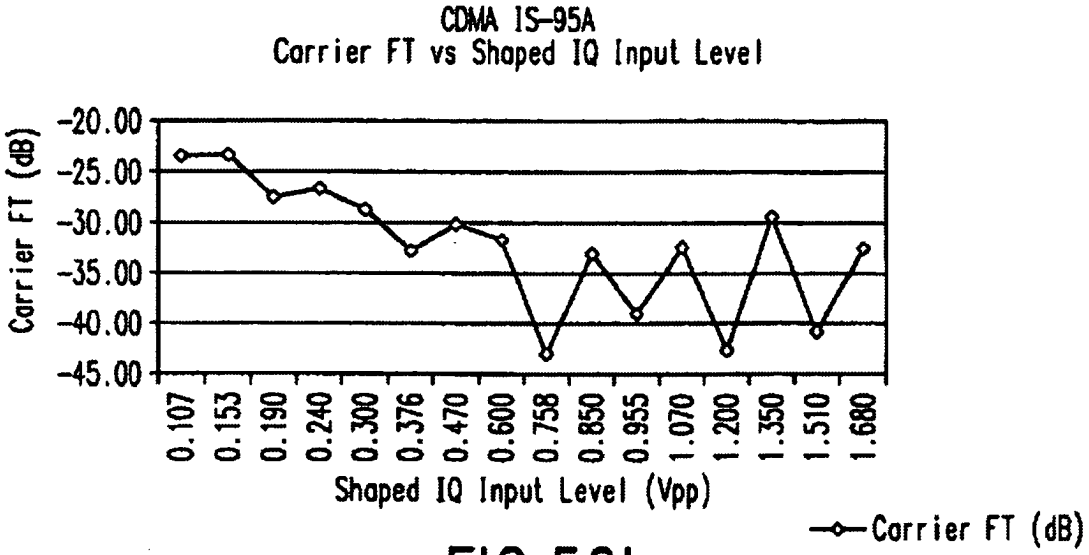


FIG.52L

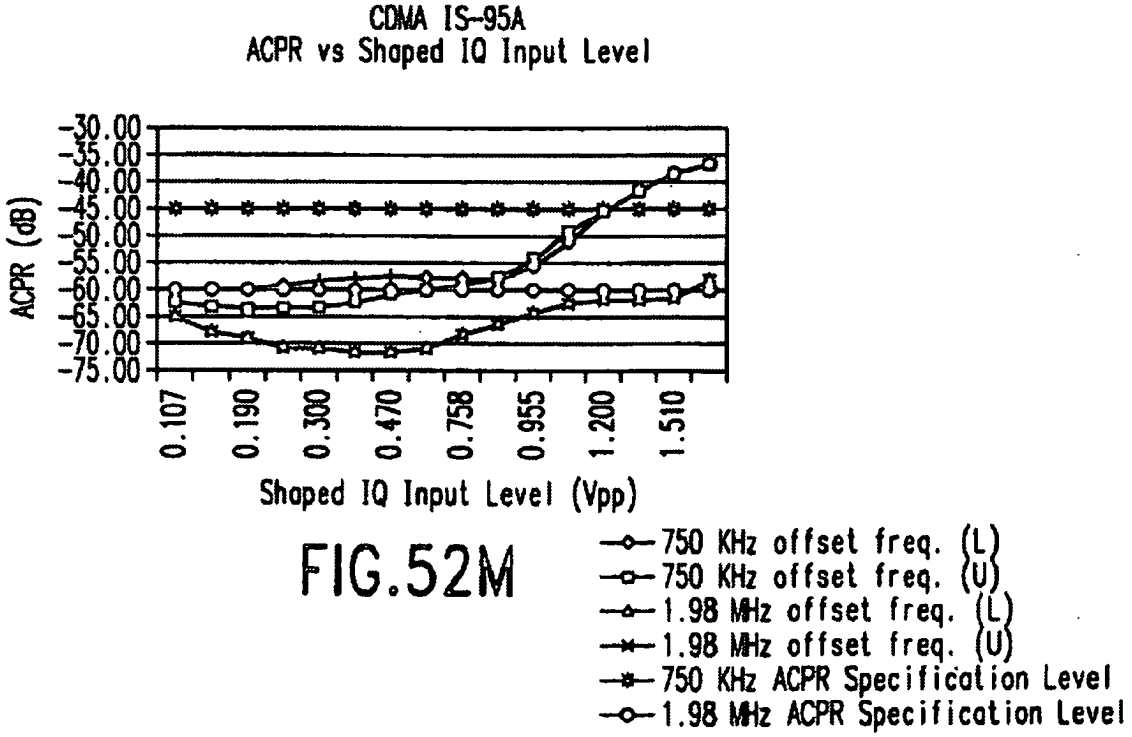


FIG.52M

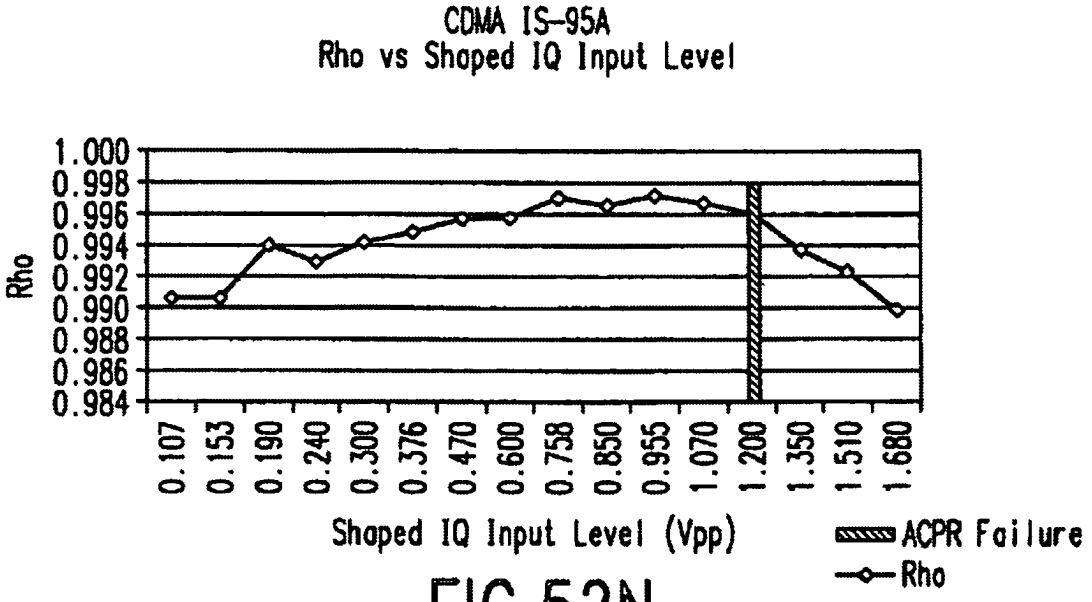


FIG.52N

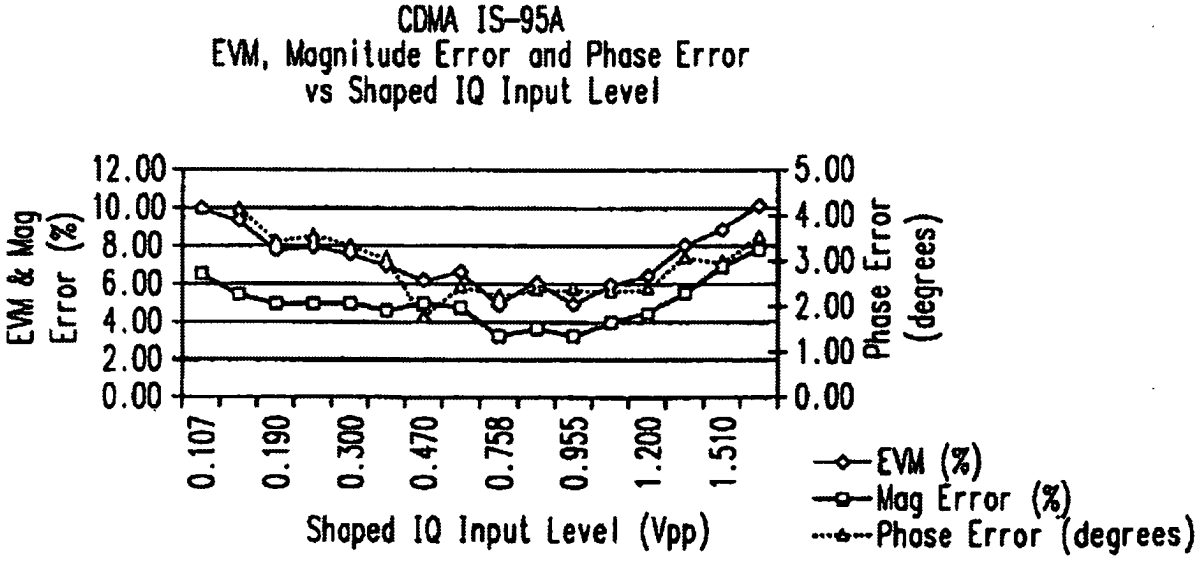


FIG.520

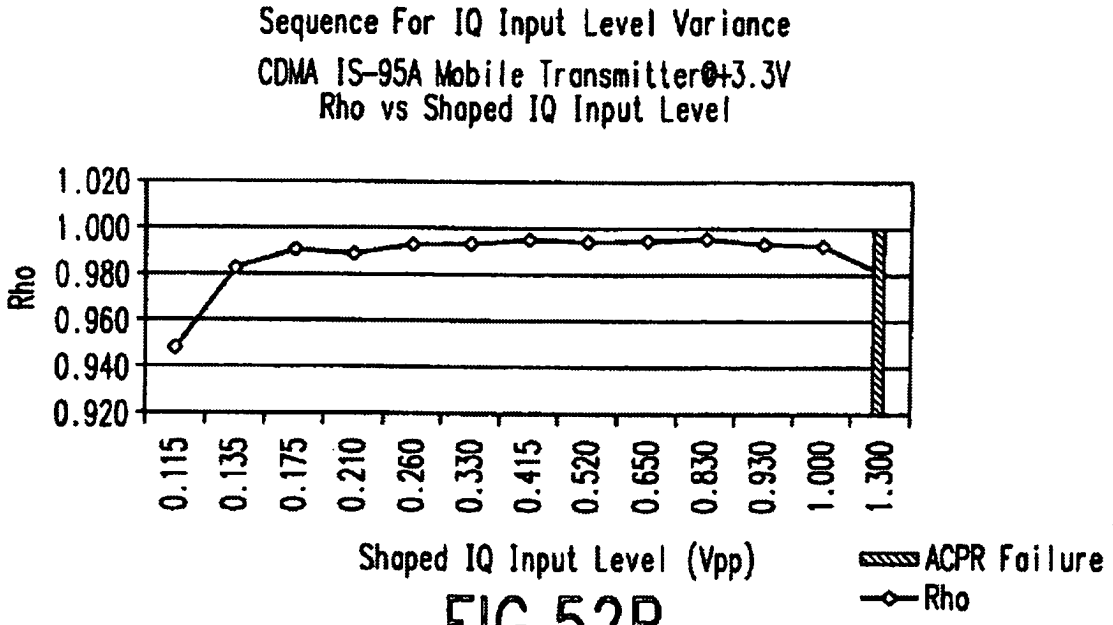


FIG.52P

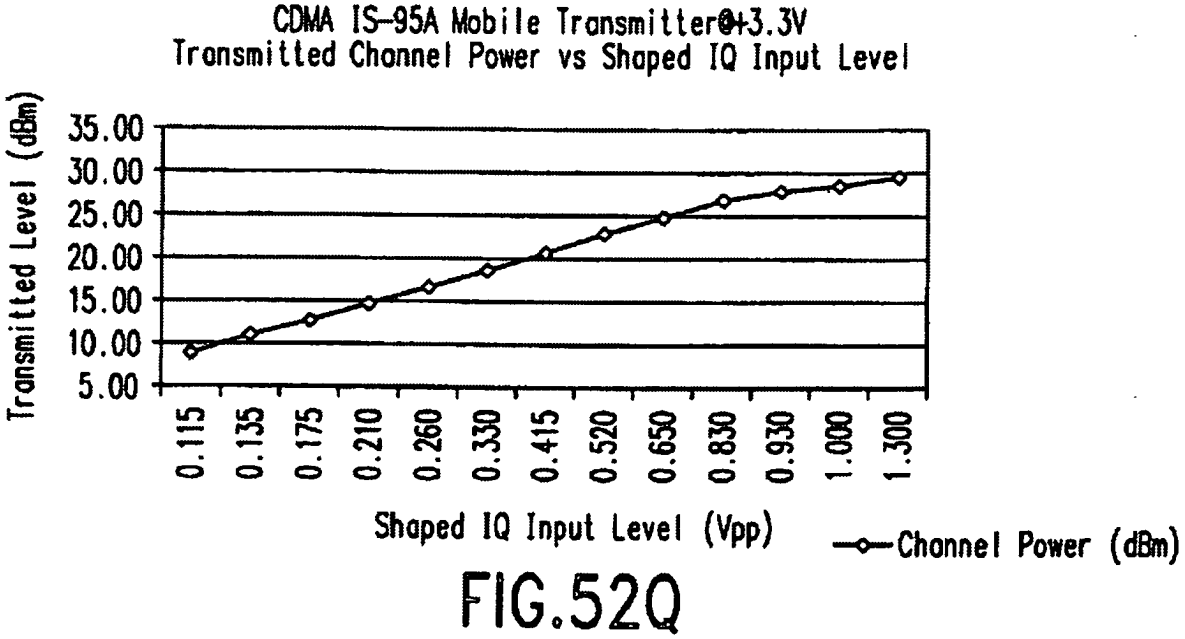


FIG.52Q

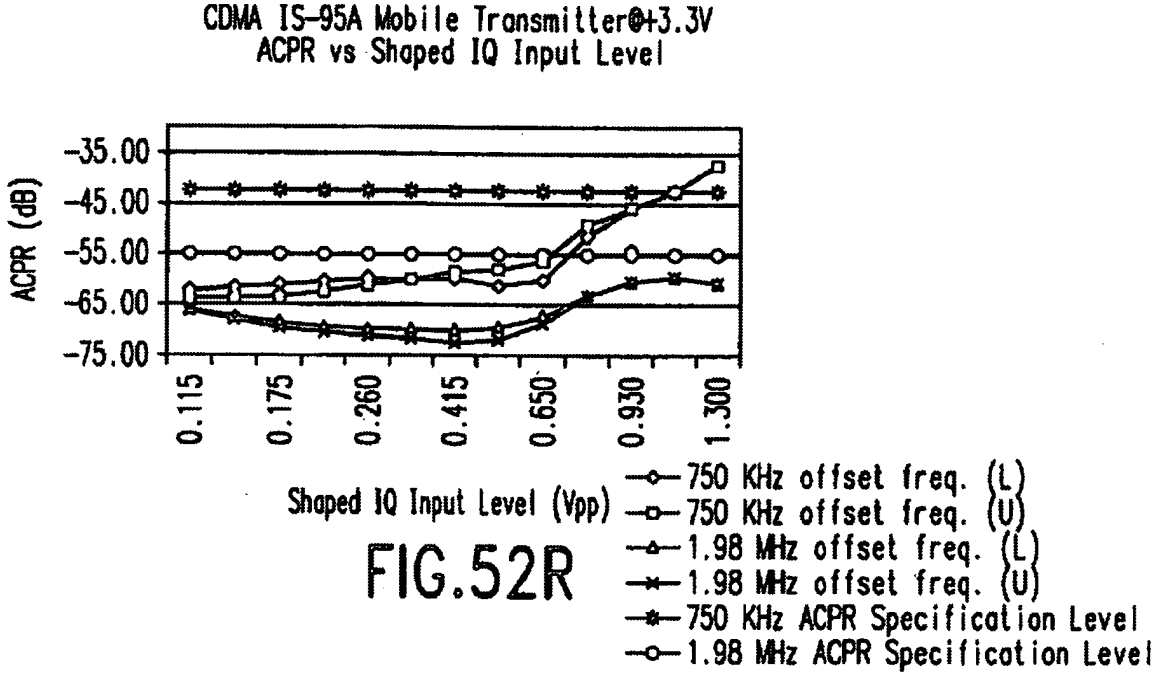


FIG.52R

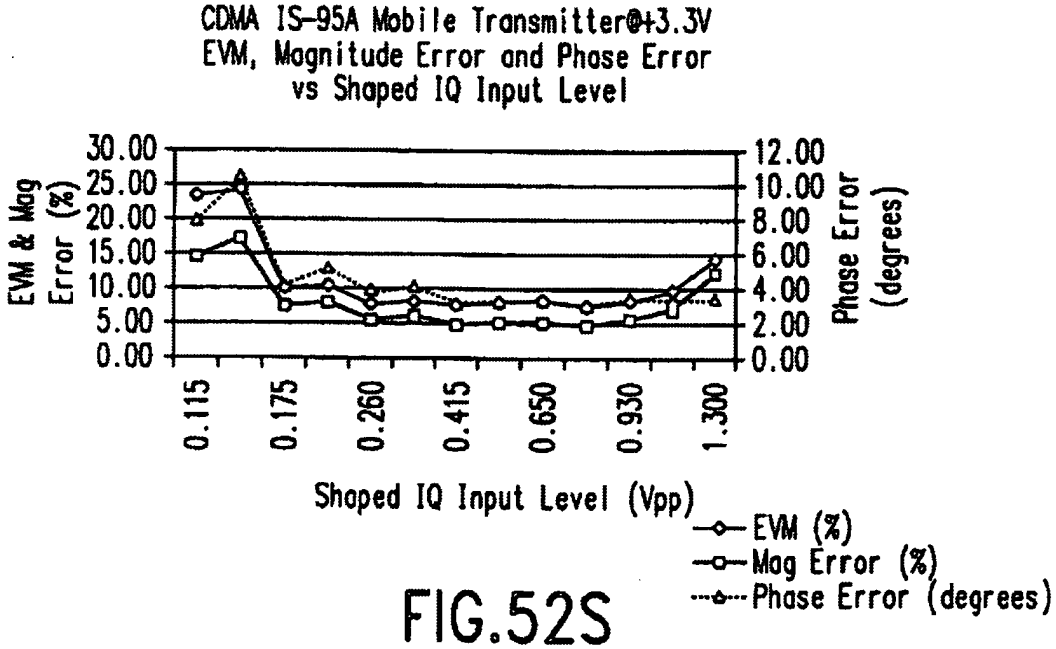


FIG.52S

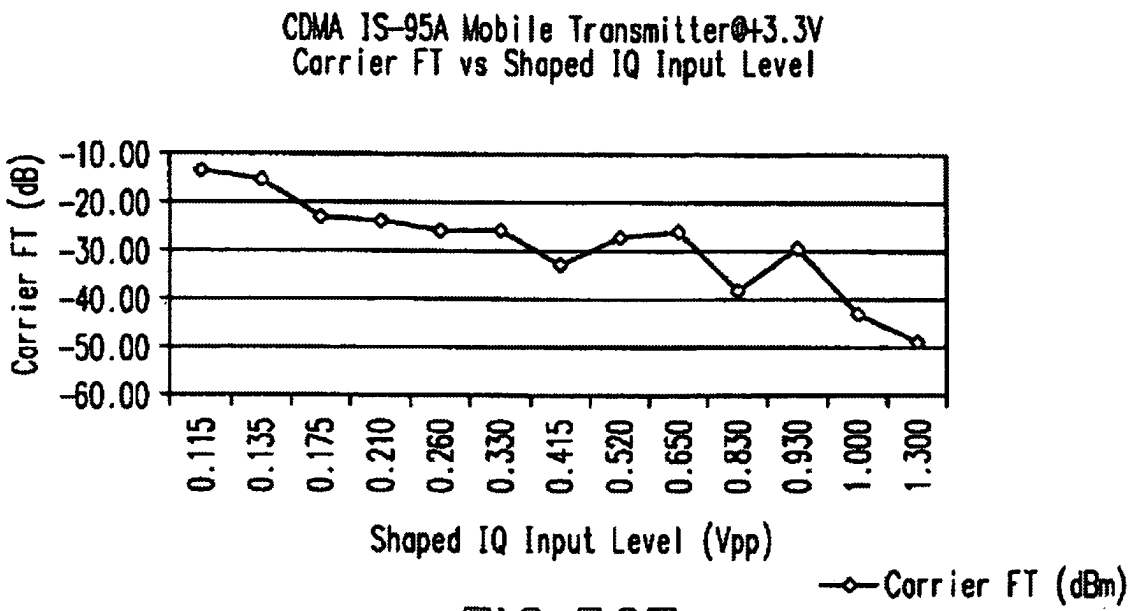


FIG.52T

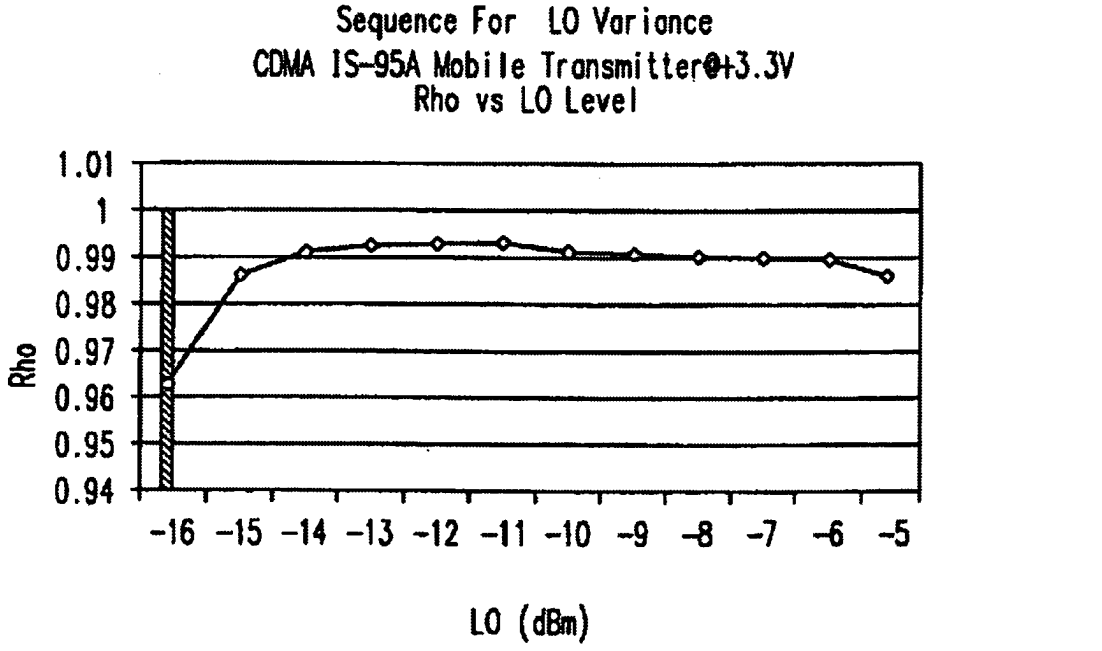


FIG.52U

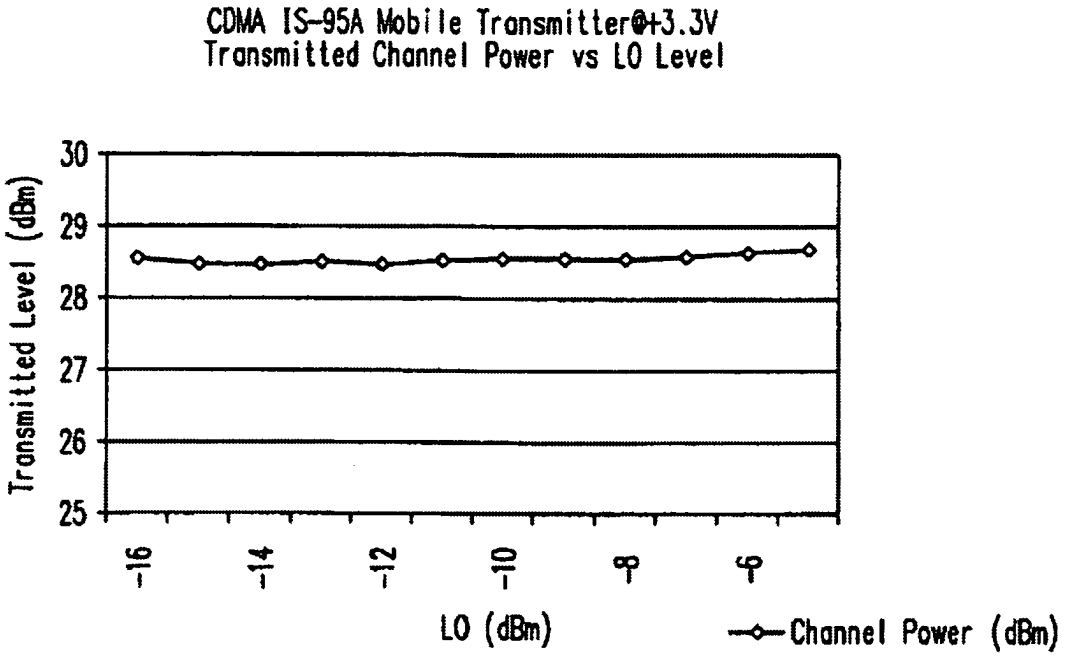


FIG.52V

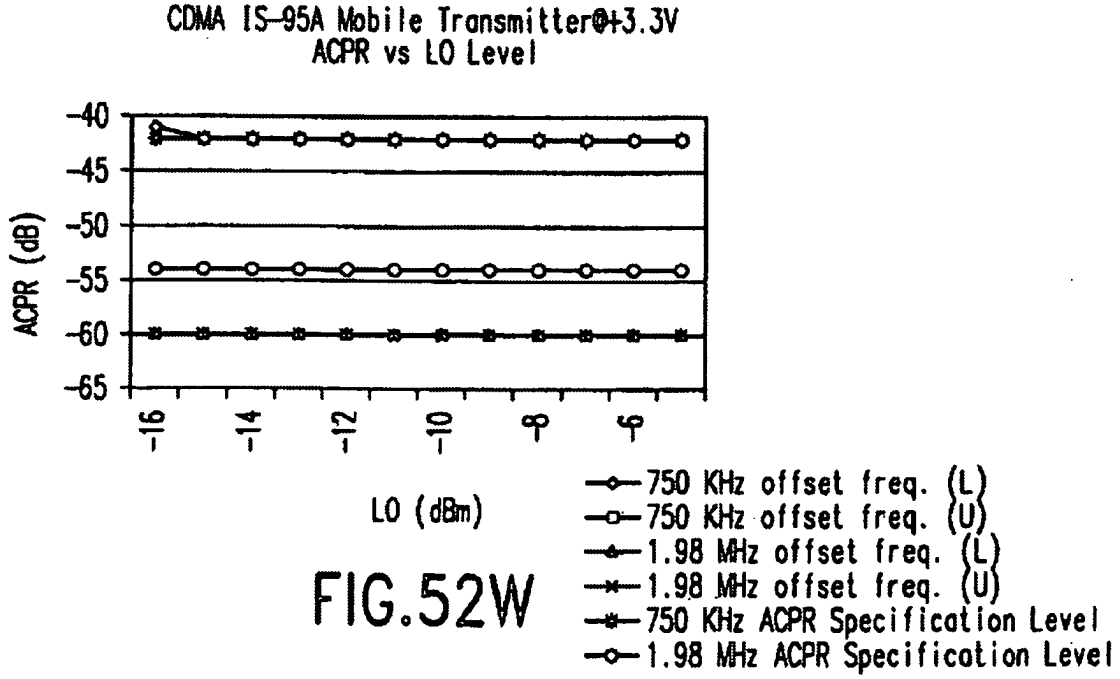


FIG.52W

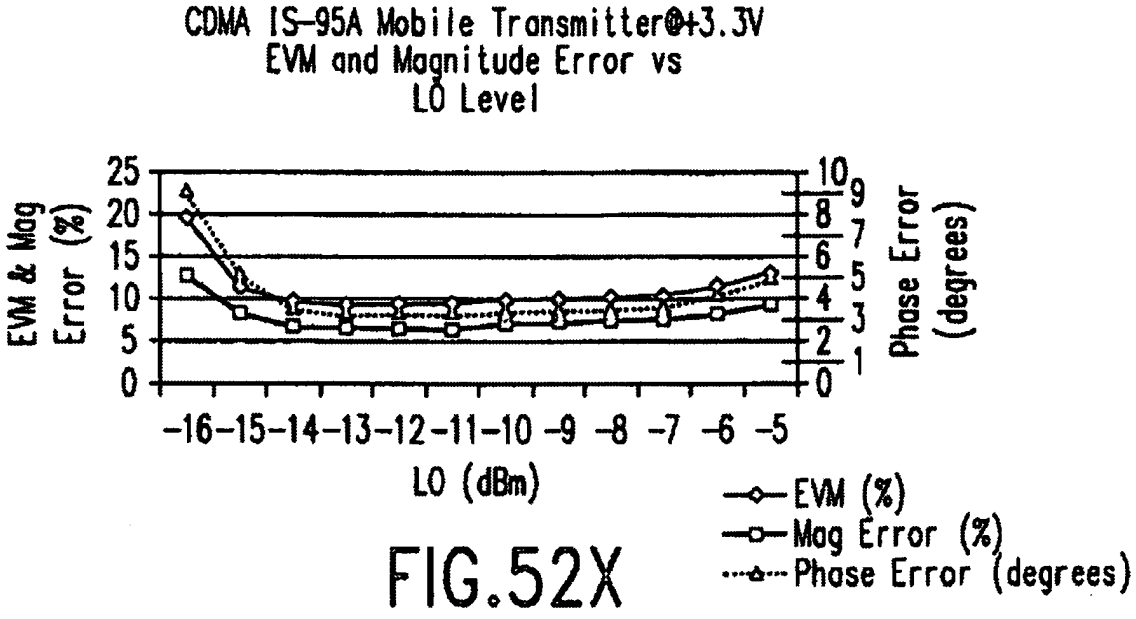


FIG.52X

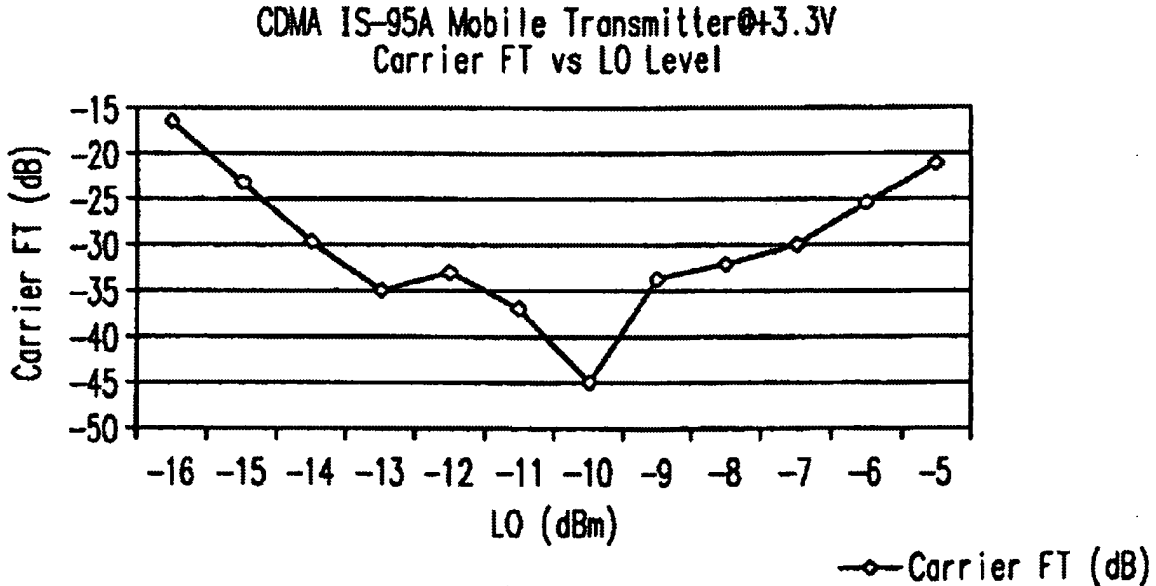


FIG.52Y

QUANTITY	DESCRIPTION	VOLTAGE	TOTAL CURRENT	POWER
2	CORES	3.3	4mA	13.2mW
2	BASEBAND INTERFACE CIRCUITS WITH/BW LIMIT	3.3	6mA	21.8mW
1	CLOCK CIRCUIT	3.3	5mA	20.0mW
			SUB TOTAL	54.0mW

FIG.52Z

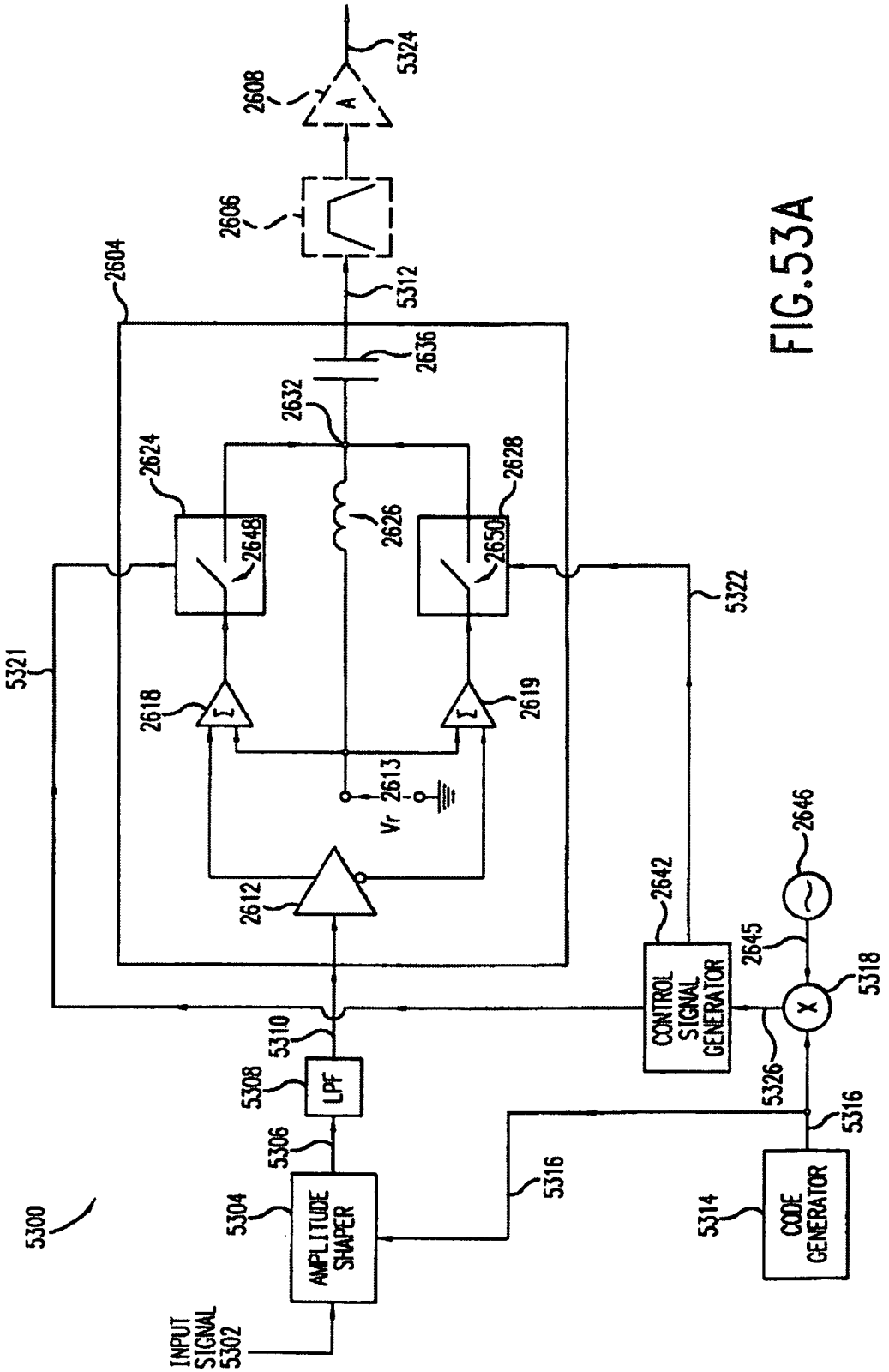

5324
2608
A
2606
2604
5312
2636
2632
2624
2628
2626
2648
2650
5322
5321
2618
2619
Σ
Σ
2613
Vr
2612
2646
2642
2645
CONTROL SIGNAL GENERATOR
5318
X
5326
5316
5310
5308
LPF
5306
5316
5304
AMPLITUDE SHAPER
5314
CODE GENERATOR
5300
INPUT SIGNAL 5302

FIG.53A

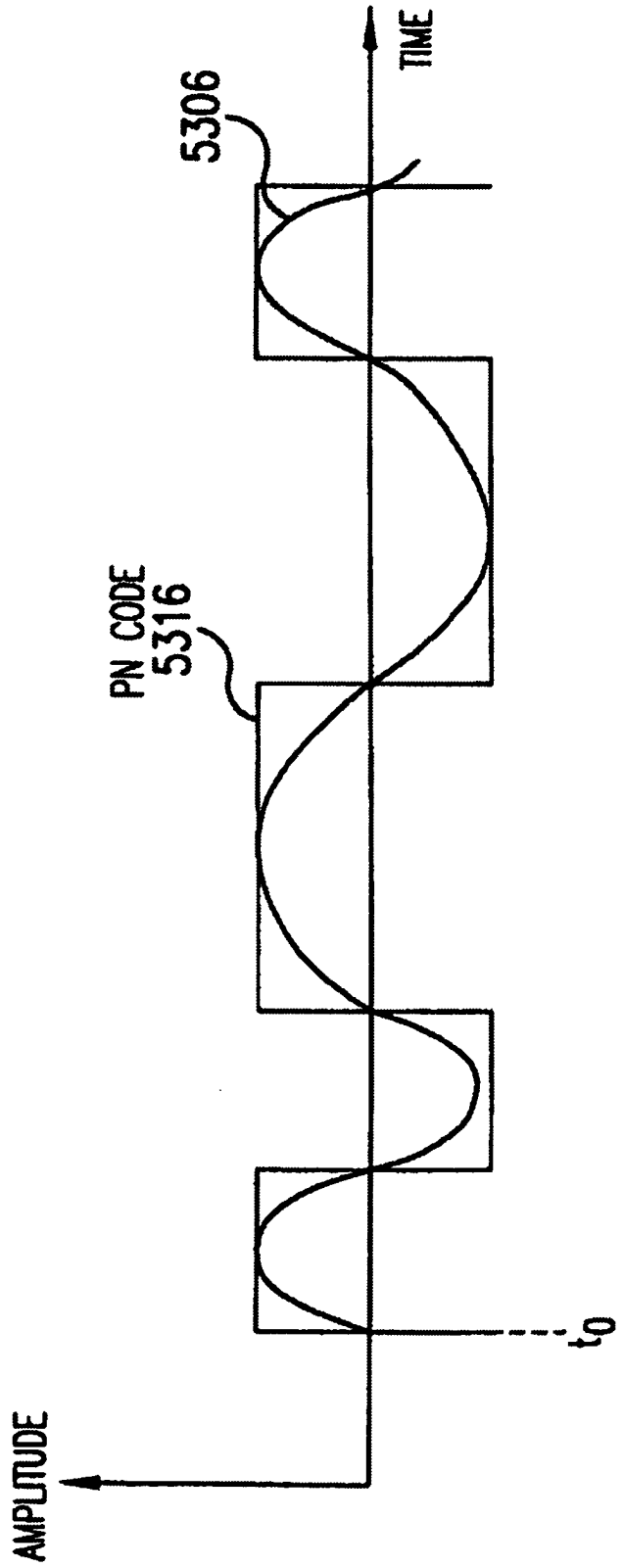


FIG.53B

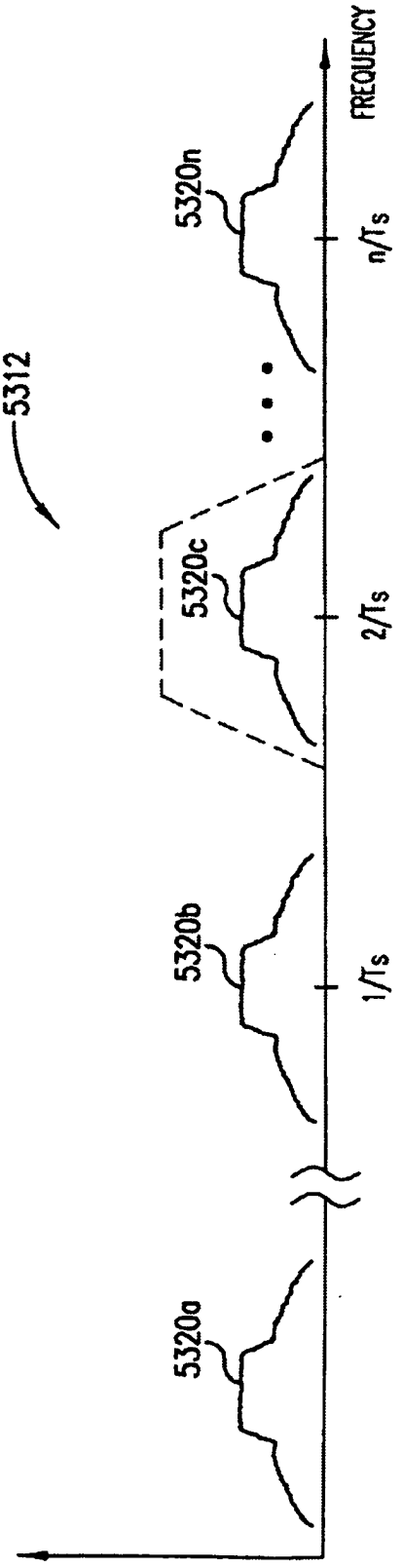


FIG.53C

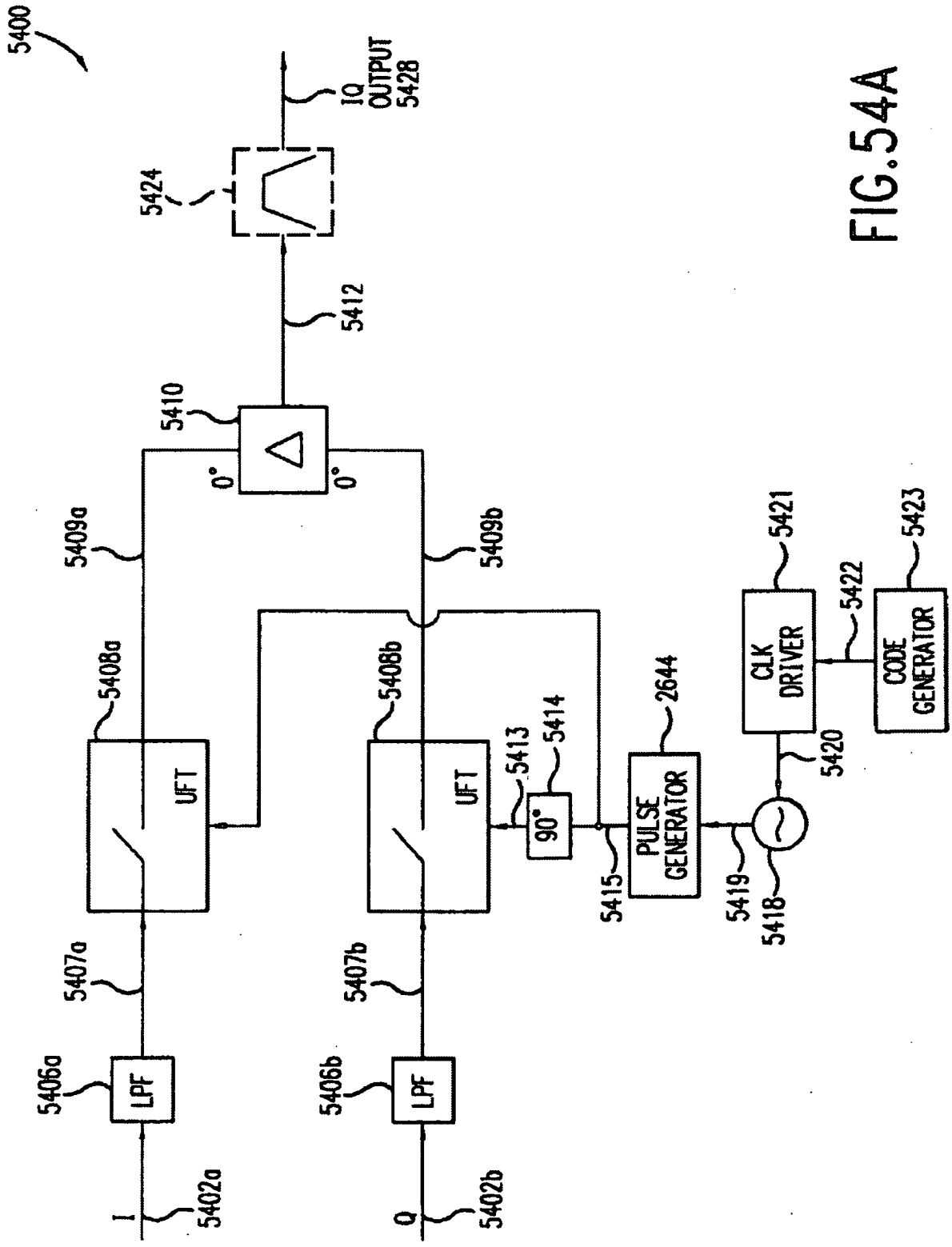

5400
IQ OUTPUT 5428
5424
5412
5410
0°
0°
5409a
5409b
5408a
5408b
UFT
UFT
5413
90°
5414
2644
PULSE GENERATOR
CLK DRIVER
5421
5422
CODE GENERATOR
5423
5420
5419
5418
5415
5407a
5407b
5406a
5406b
LPF
LPF
I
Q
5402a
5402b

FIG.54A

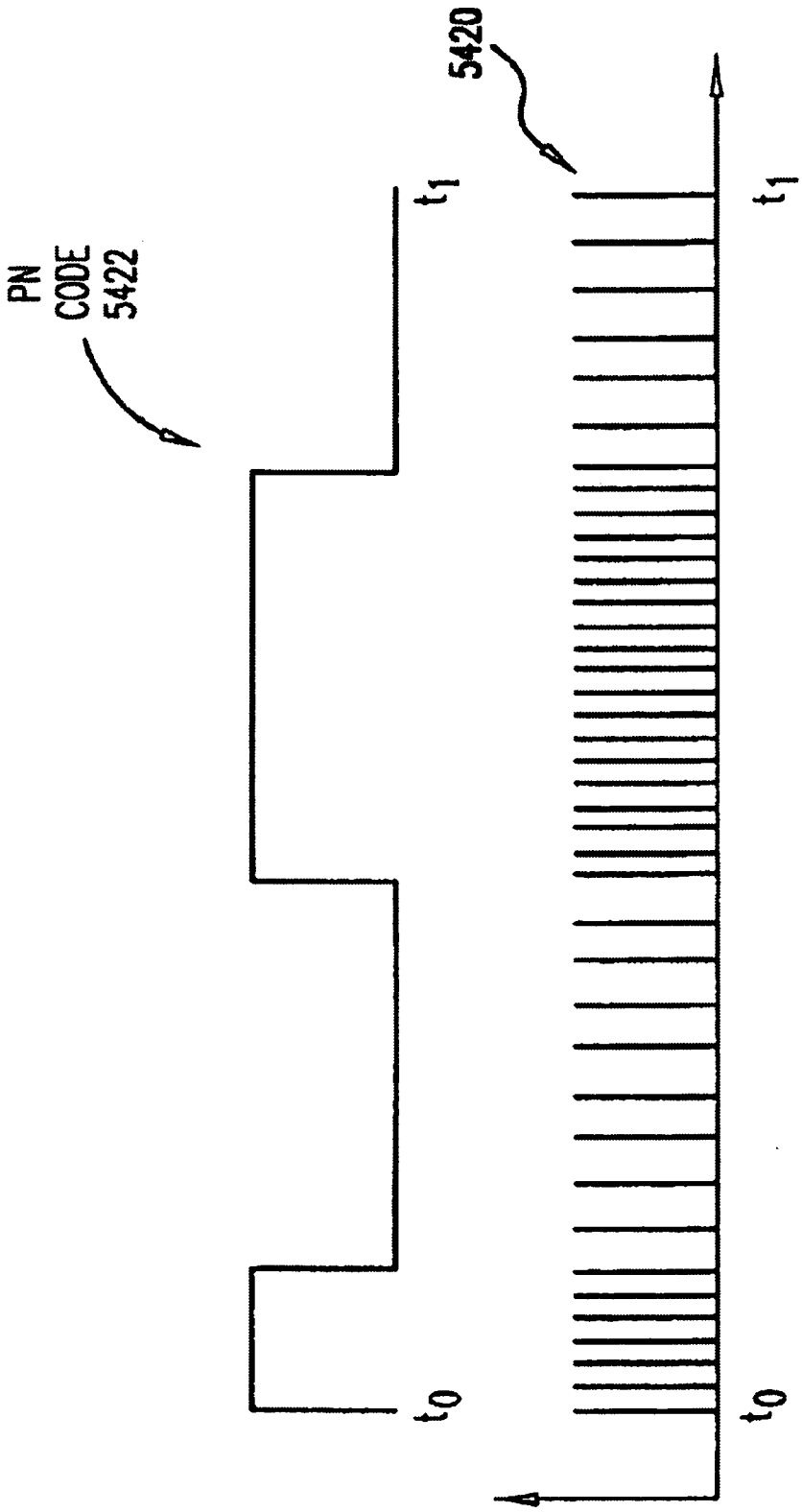


FIG.54B

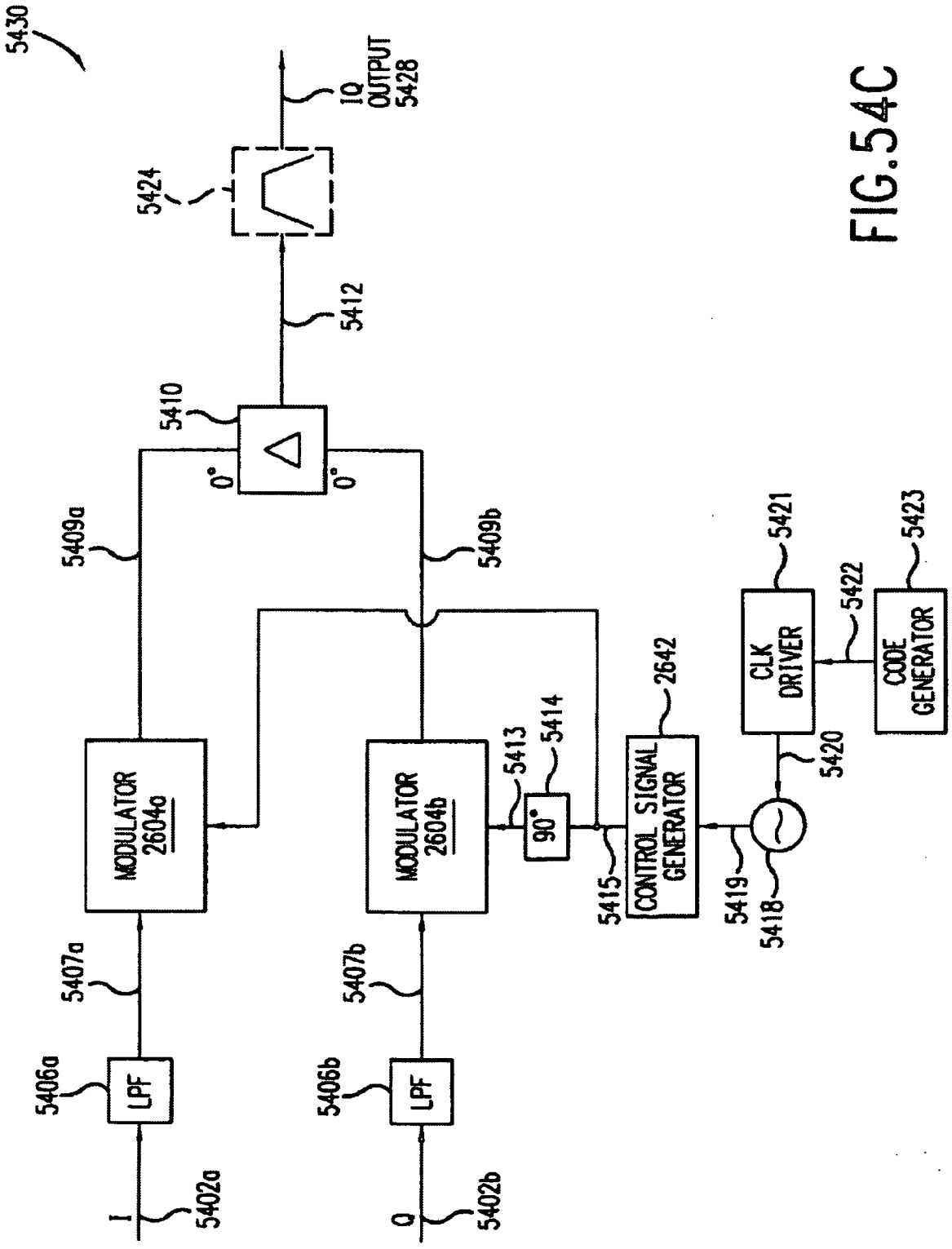

5430
IQ OUTPUT 5428
5424
5412
5410
0°
0°
5409a
5409b
MODULATOR 2604a
MODULATOR 2604b
5413
5414
90°
2642
CONTROL SIGNAL GENERATOR
CLK DRIVER
CODE GENERATOR
5421
5422
5423
5420
5419
5418
5415
5407a
5407b
5406a
5406b
LPF
LPF
I
Q
5402a
5402b

FIG.54C

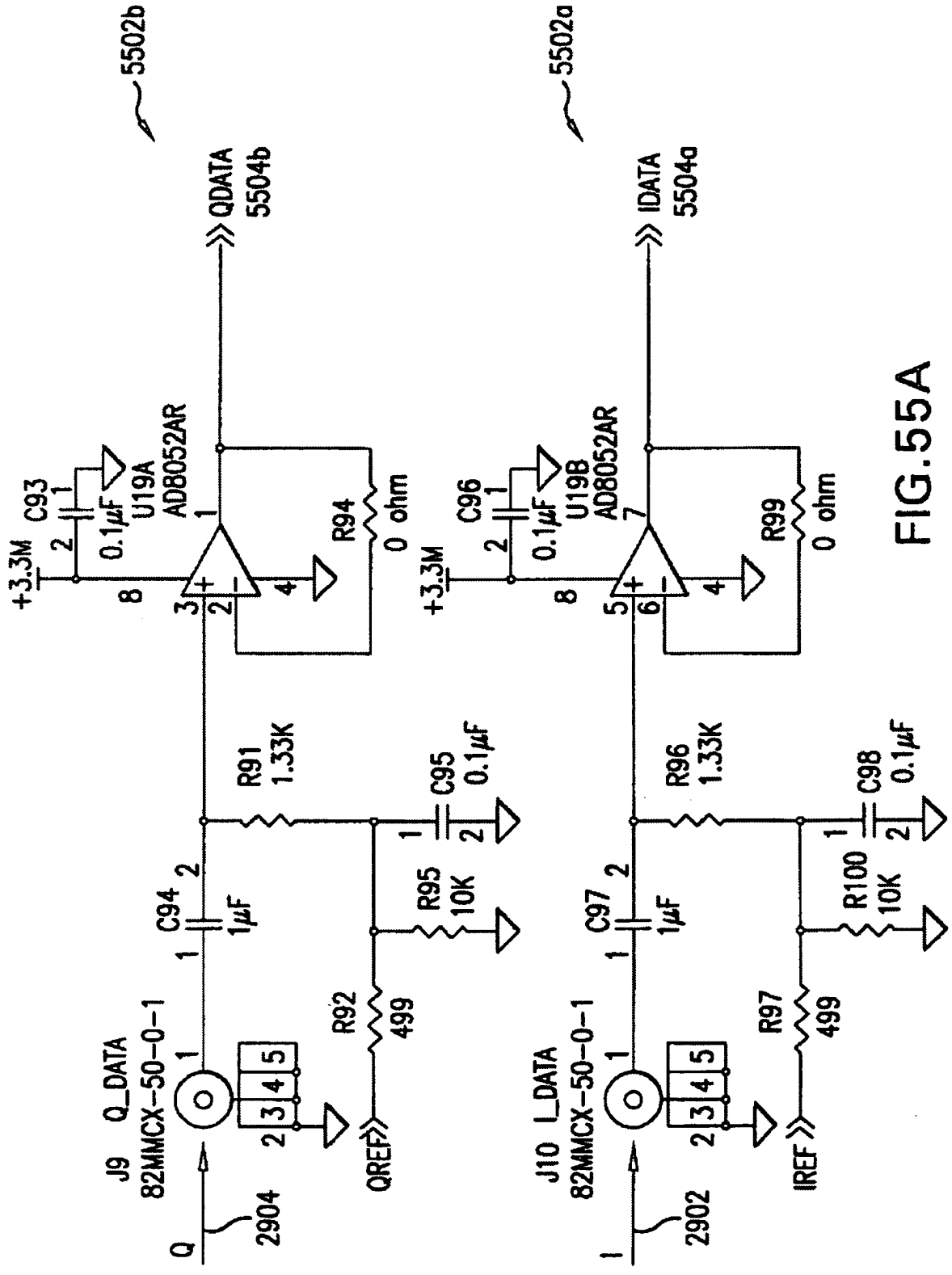

5502b
5502a
QDATA
5504b
IDATA
5504a
U19A
AD8052AR
U19B
AD8052AR
C93
0.1µF
C96
0.1µF
+3.3M
+3.3M
R94
0 ohm
R99
0 ohm
R91
1.33K
R96
1.33K
C95
0.1µF
C98
0.1µF
C94
1µF
C97
1µF
R95
10K
R100
10K
R92
499
R97
499
J9 Q_DATA
82MMCX-50-0-1
J10 I_DATA
82MMCX-50-0-1
QREF
IREF
Q
I
2904
2902

FIG.55A

FIG.55 B-1	FIG.55 B-2	FIG.55 B-3	FIG.55 B-4

FIG.55B

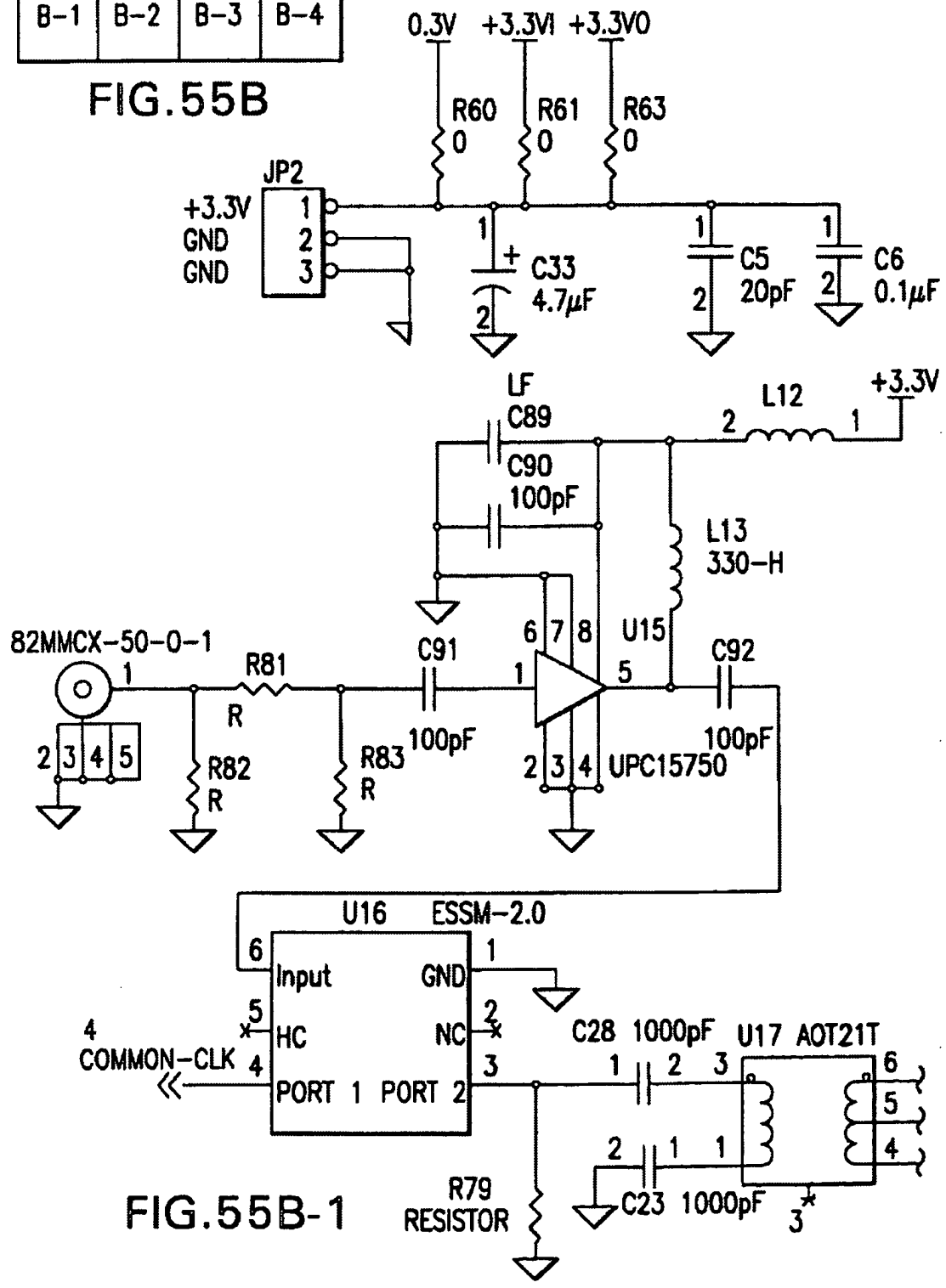


FIG.55B-1

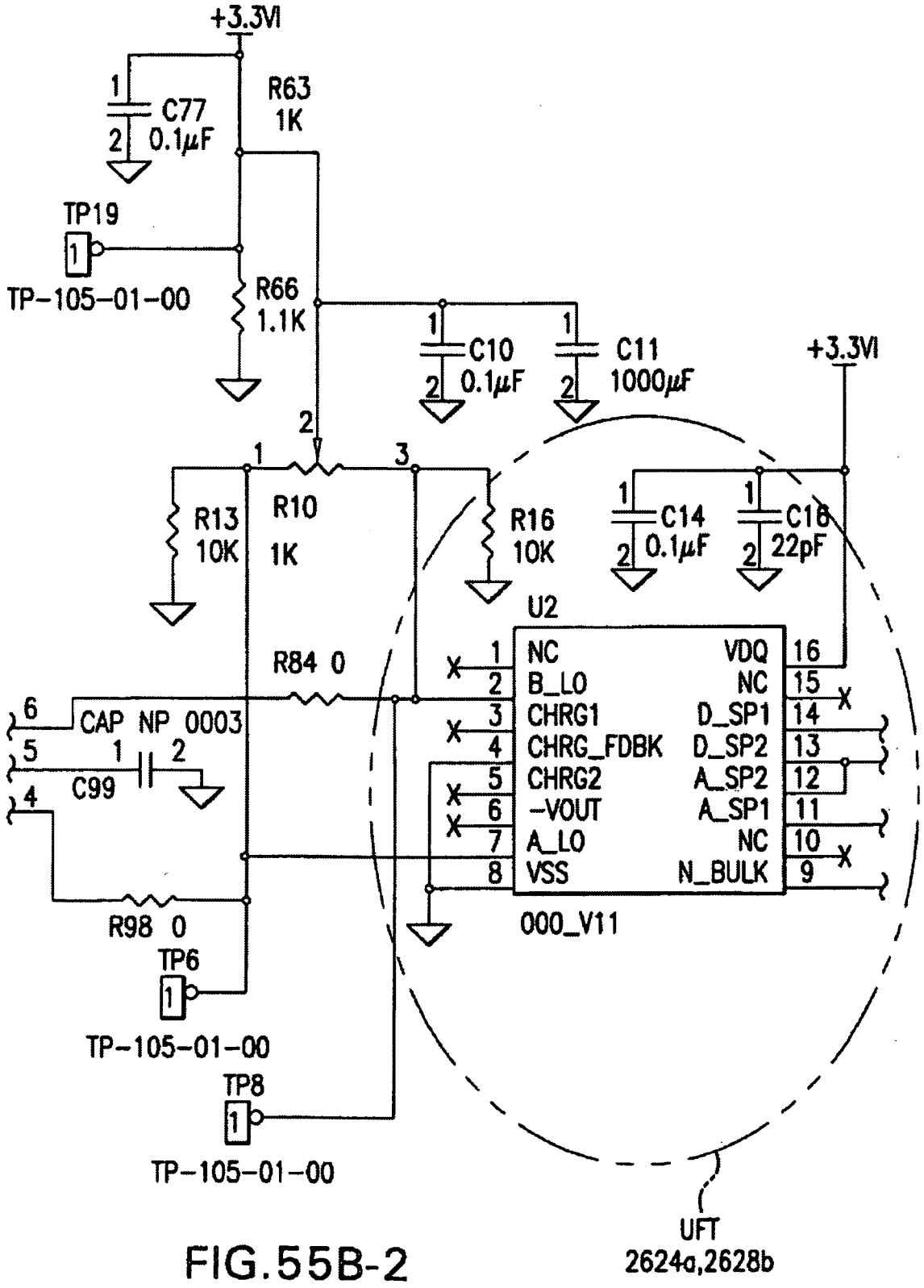

+3.3VI
C77
0.1µF
R63
1K
TP19
TP-105-01-00
R66
1.1K
C10
0.1µF
C11
1000µF
+3.3VI
R13
10K
R10
1K
R16
10K
C14
0.1µF
C16
22pF
U2
R84 0
NC
B_LO
CHRG1
CHRG_FDBK
CHRG2
-VOUT
A_LO
VSS
VDQ
NC
D_SP1
D_SP2
A_SP2
A_SP1
NC
N_BULK
CAP NP 0003
C99
R98 0
TP6
TP-105-01-00
TP8
TP-105-01-00
000_V11
UFT
2624a,2628b

FIG.55B-2

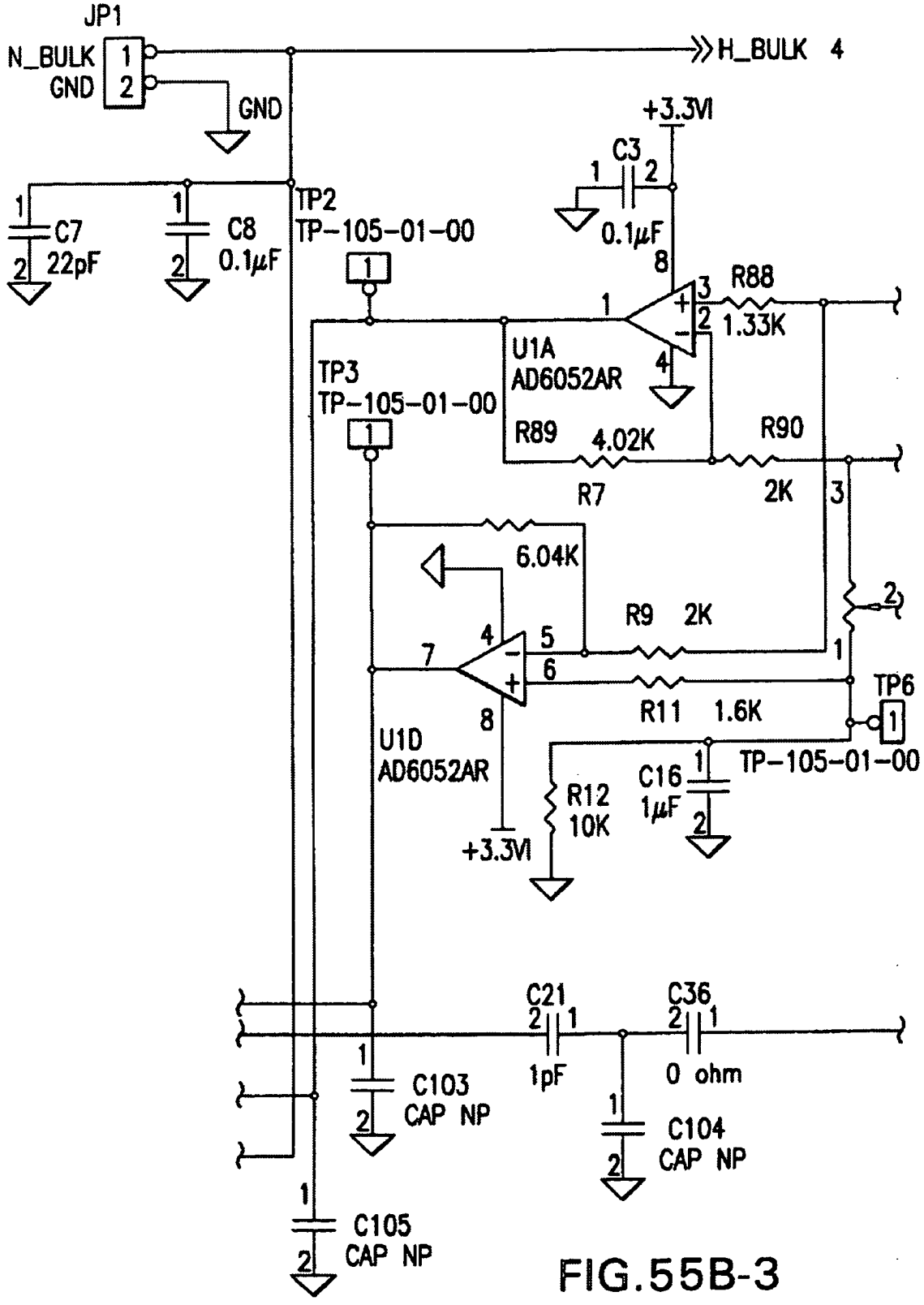

JP1
N_BULK
GND
GND
H_BULK 4
+3.3VI
C3
0.1µF
C7
22pF
C8
0.1µF
TP2
TP-105-01-00
R88
1.33K
U1A
AD6052AR
TP3
TP-105-01-00
R89
4.02K
R90
2K
R7
6.04K
R9 2K
U1D
AD6052AR
TP6
TP-105-01-00
R11 1.6K
R12
10K
C16
1µF
+3.3VI
C21
1pF
C36
0 ohm
C103
CAP NP
C104
CAP NP
C105
CAP NP

FIG.55B-3

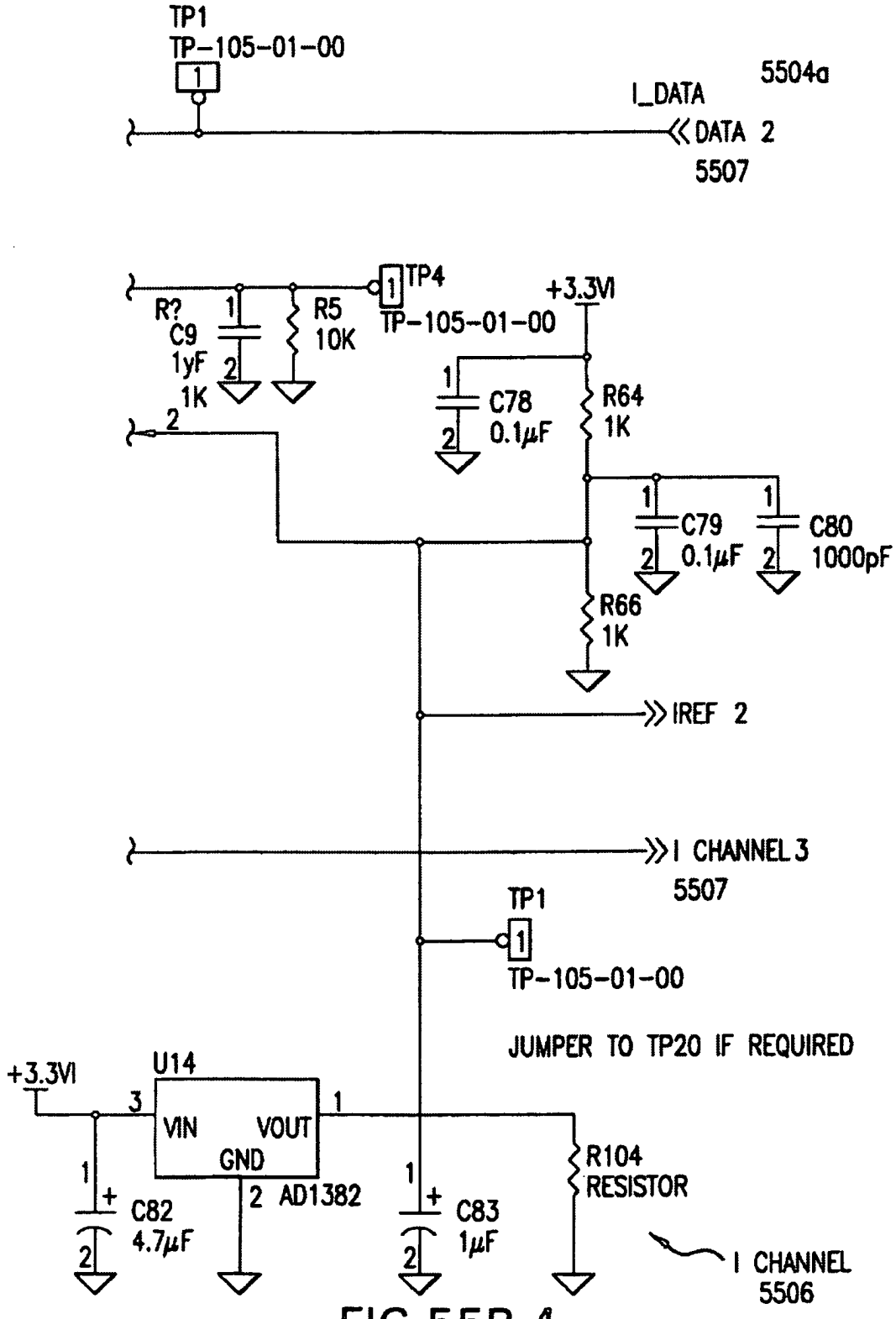

TP1
TP-105-01-00
I_DATA
5504a
DATA 2
5507
R?
C9
1yF
1K
R5
10K
TP4
TP-105-01-00
+3.3VI
C78
0.1μF
R64
1K
C79
0.1μF
C80
1000pF
R66
1K
IREF 2
I CHANNEL 3
5507
TP1
TP-105-01-00
JUMPER TO TP20 IF REQUIRED
+3.3VI
U14
VIN
VOUT
GND
AD1382
C82
4.7μF
C83
1μF
R104
RESISTOR
I CHANNEL
5506

FIG.55B-4

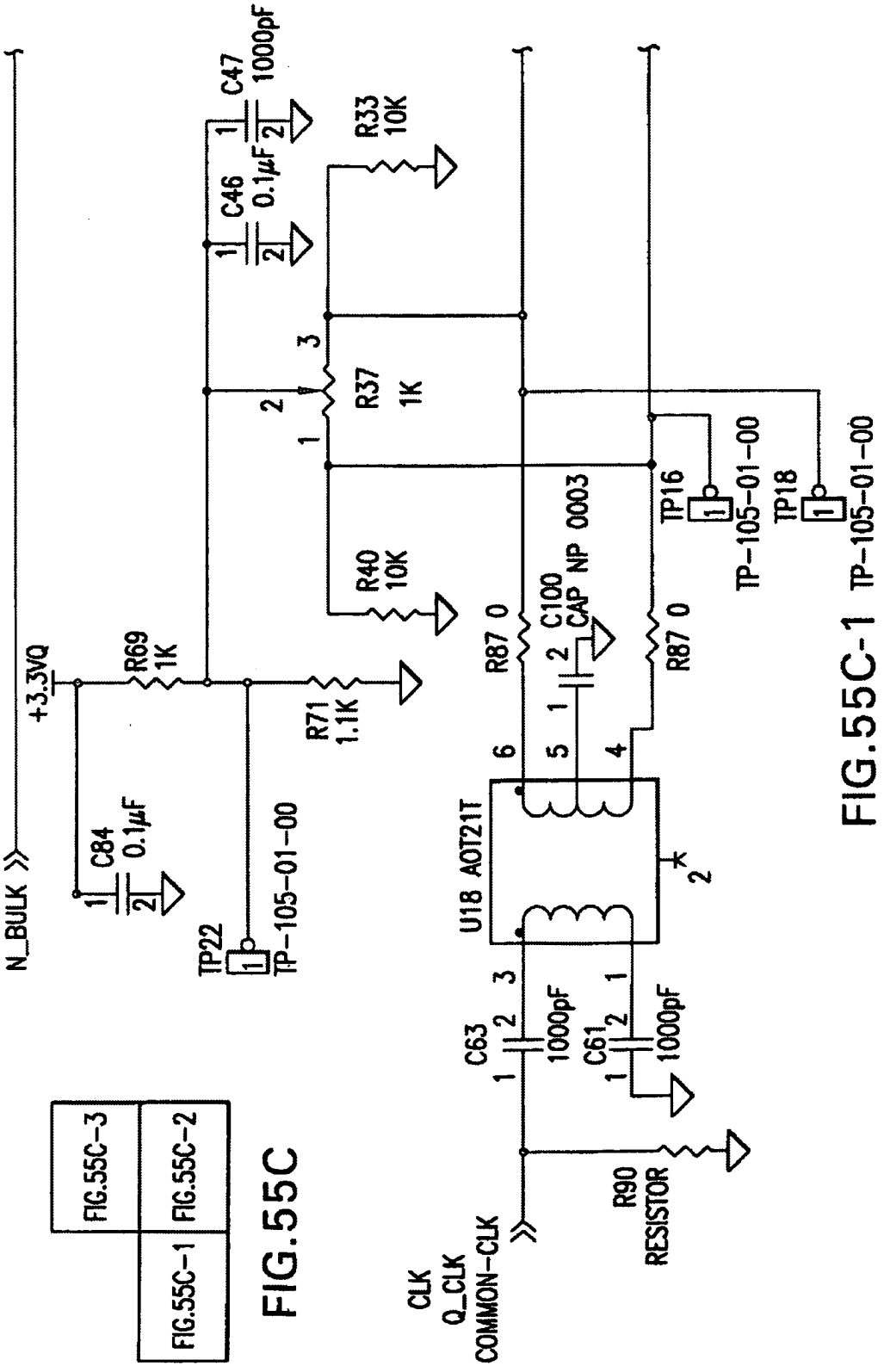


FIG.55C-3
FIG.55C-2
FIG.55C-1
FIG.55C
FIG.55C-1
N_BULK
+3.3VQ
C84 0.1µF
R69 1K
TP22
TP-105-01-00
R71 1.1K
C47 1000pF
C46 0.1µF
R33 10K
R37 1K
R40 10K
R87 0
C100 CAP NP 0003
R87 0
TP16
TP-105-01-00
TP18
TP-105-01-00
U18 AOT21T
C63 1000pF
C61 1000pF
R90 RESISTOR
CLK
Q_CLK
COMMON-CLK

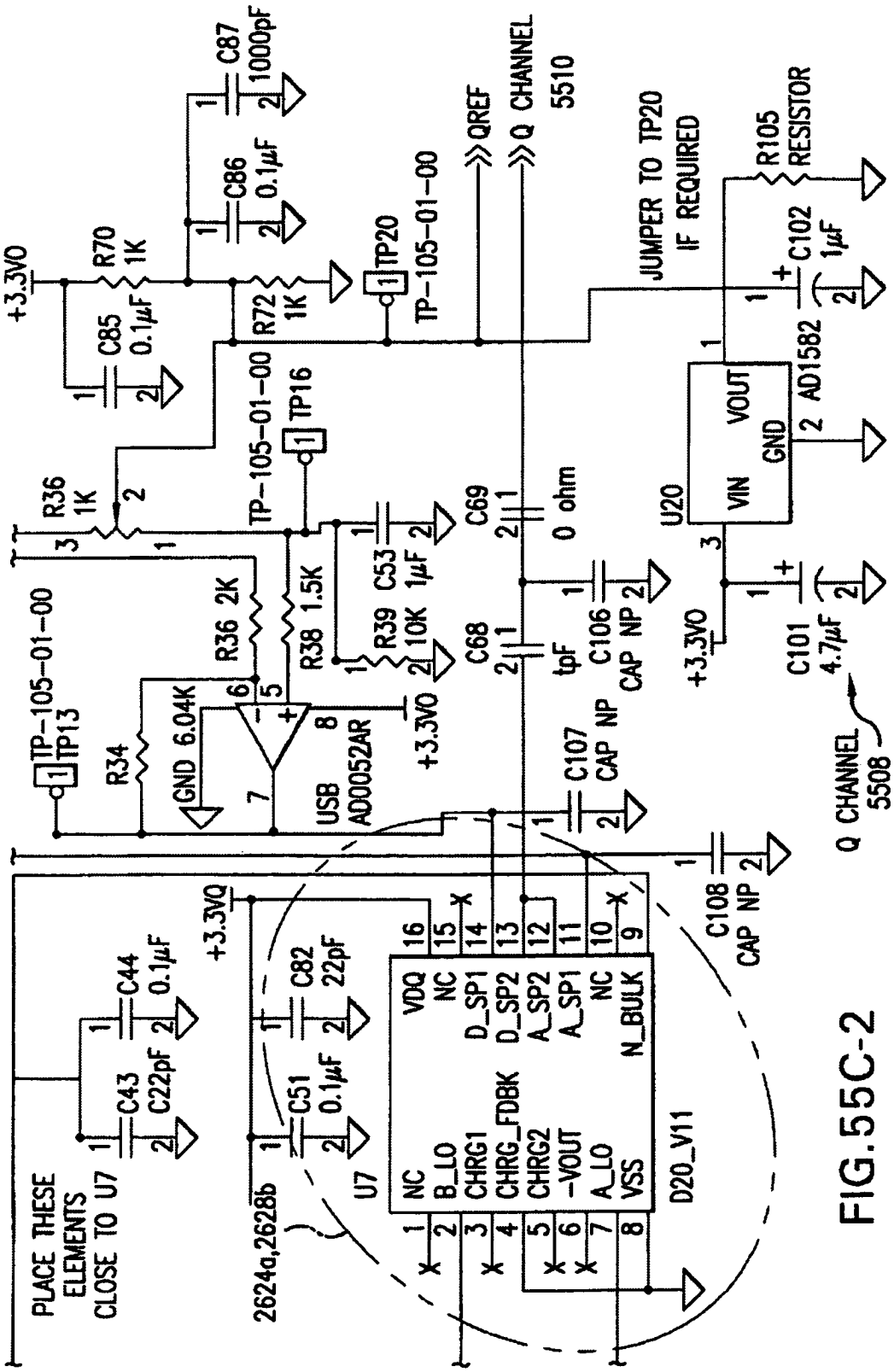

+3.3VQ
R70 1K
C85 0.1µF
C86 0.1µF
C87 1000pF
TP20
TP-105-01-00
>>QREF
>>Q CHANNEL 5510
JUMPER TO TP20 IF REQUIRED
R105 RESISTOR
C102 1µF
U20
VIN
VOUT
GND
AD1582
TP16
R36 1K
R36 2K
R38 1.5K
C53 1µF
R39 10K
C69 0 ohm
C68 tpF
C106 CAP NP
C101 4.7µF
TP13
R34
GND 6.04K
USB AD0052AR
C107 CAP NP
C108 CAP NP
Q CHANNEL 5508
C44 0.1µF
C43 C22pF
C82 22pF
C51 0.1µF
PLACE THESE ELEMENTS CLOSE TO U7
2624a,2628b
U7
VDQ
NC
D_SP1
D_SP2
A_SP2
A_SP1
NC
N_BULK
NC
B_LO
CHRG1
CHRG_FDBK
CHRG2
-VOUT
A_LO
VSS
D20_V11

FIG.55C-2

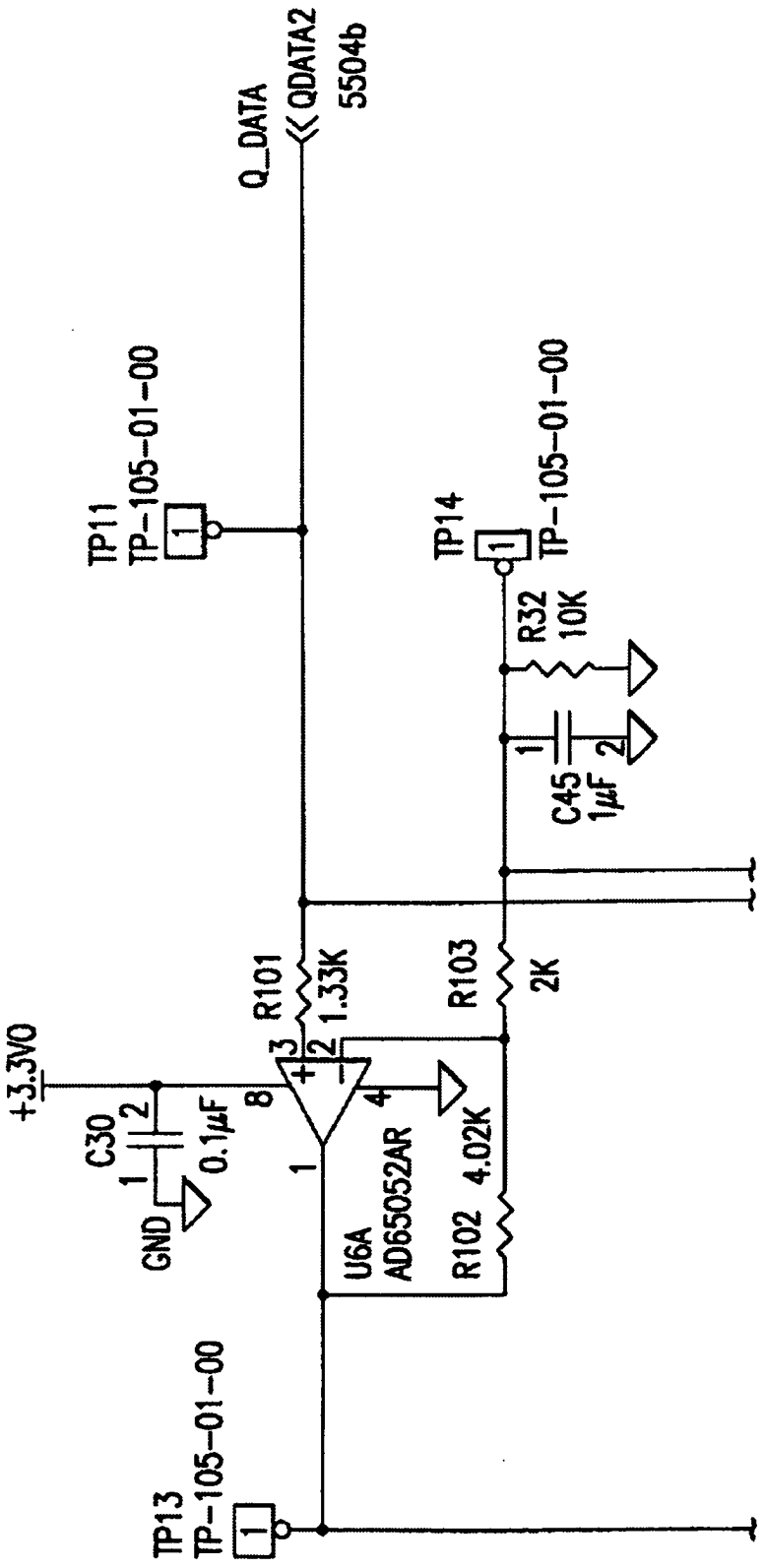

Q_DATA
QDATA2
5504b
TP11
TP-105-01-00
TP14
TP-105-01-00
R32
10K
C45
1μF
R101
1.33K
R103
2K
+3.3V0
C30
0.1μF
GND
U6A
AD65052AR
R102
4.02K
TP13
TP-105-01-00

FIG.55C-3

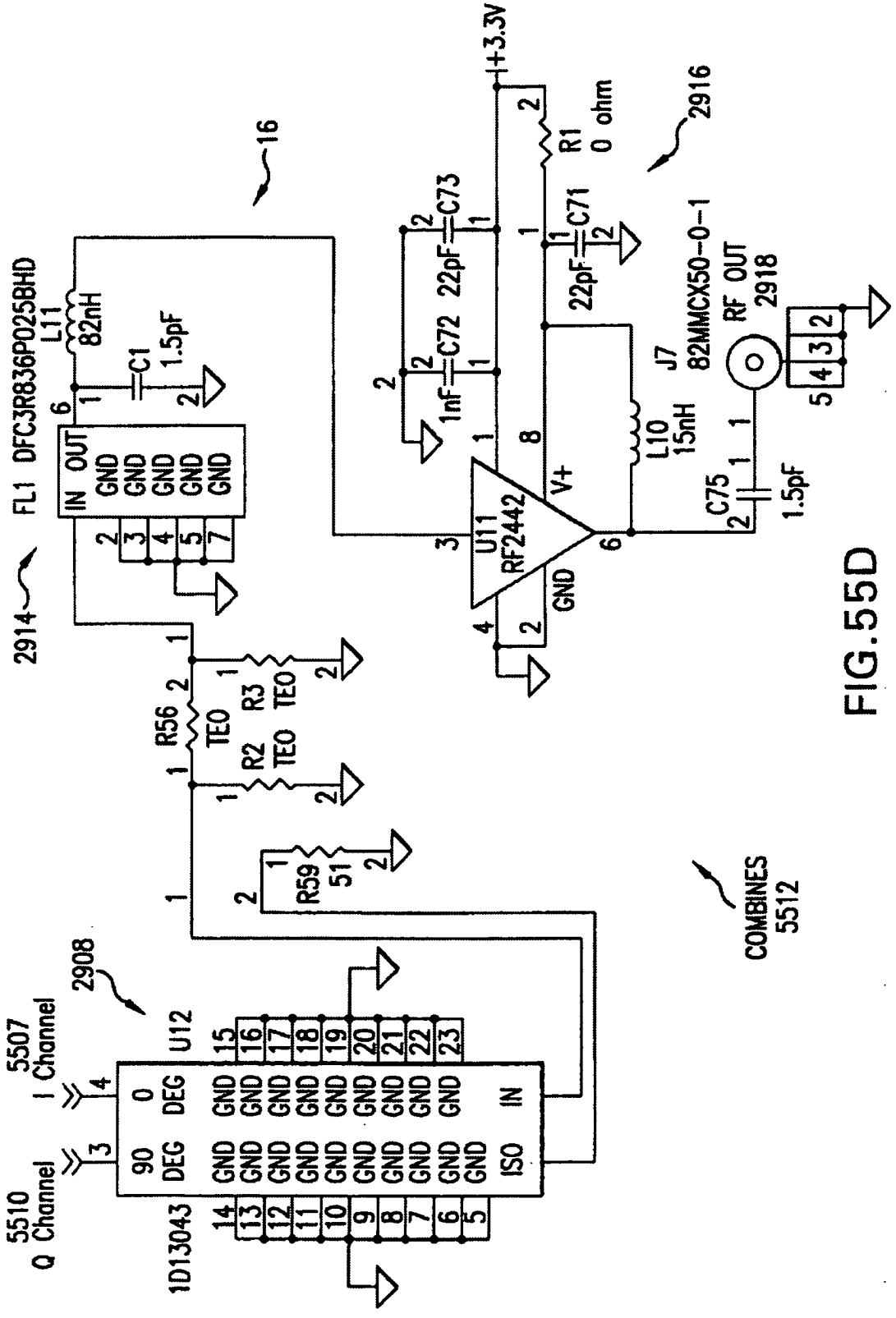

16
2914
FL1 DFC3R836P025BHD
L11
82nH
C1
1.5pF
IN OUT GND GND GND GND GND
R56 TEO
R2 TEO
R3 TEO
R59 51
2908
U12
5507
I Channel
5510
Q Channel
1D13043
0 DEG
90 DEG
IN
ISO
GND
+3.3V
R1
0 ohm
2916
C73
22pF
C72
1nF
C71
22pF
U11
RF2442
V+
GND
L10
15nH
J7
82MMCX50-0-1
RF OUT
2918
C75
1.5pF
COMBINES
5512

FIG.55D

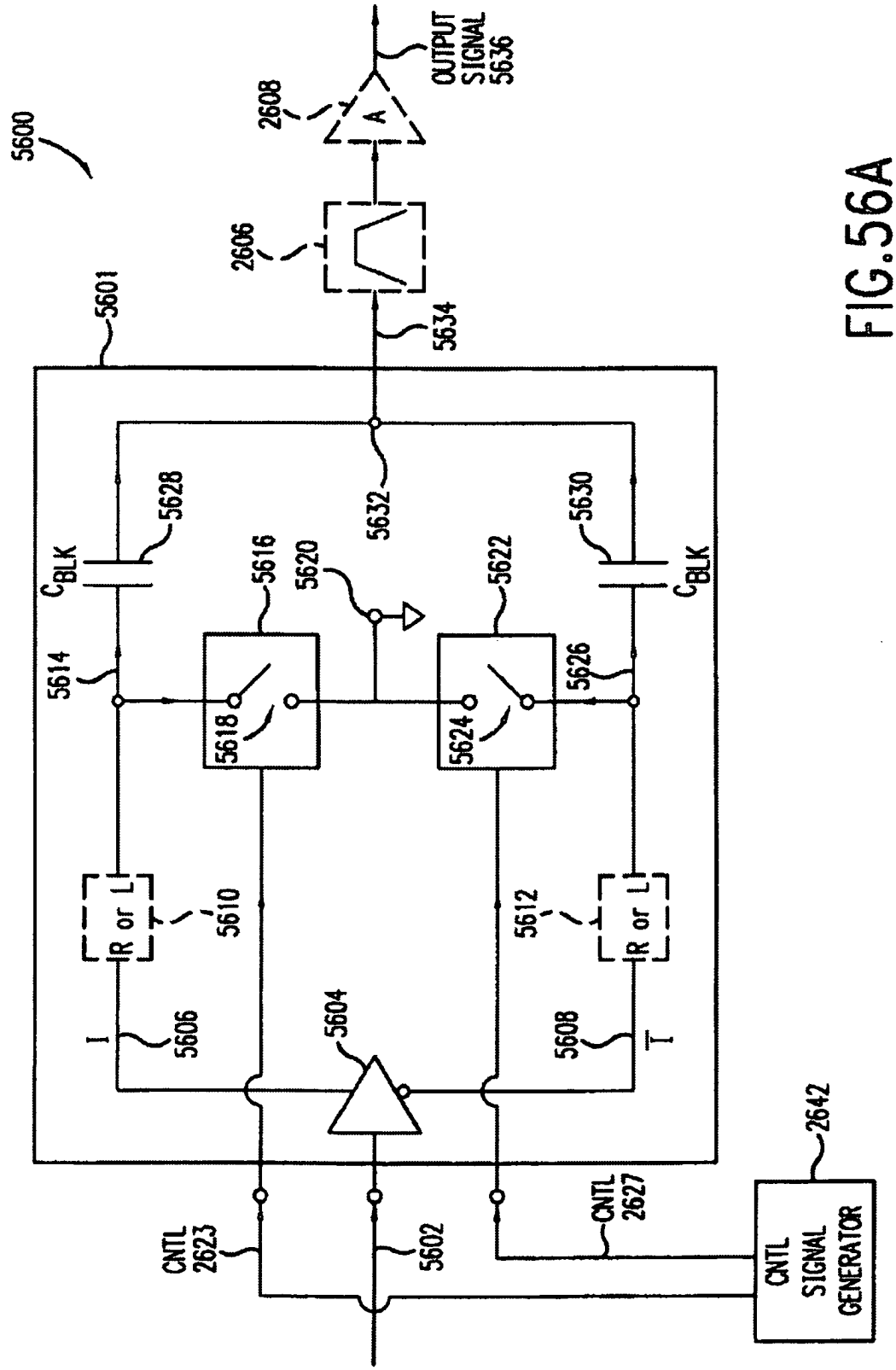

5600
2608
A
OUTPUT SIGNAL 5636
2606
5601
5634
5632
5628
5630
C_{BLK}
C_{BLK}
5616
5620
5622
5614
5626
5618
5624
R or L
5610
5612
R or L
I
5606
5604
5608
$\overline{I}$
2642
CNTL 2627
CNTL 2623
5602
CNTL SIGNAL GENERATOR

FIG.56A

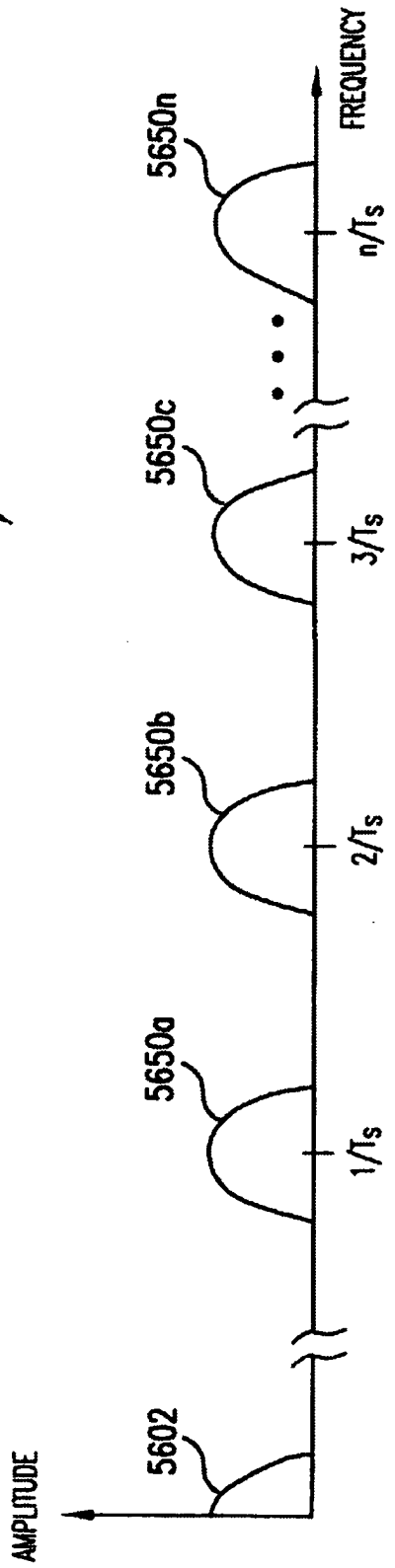

5614
5650n
5650c
5650b
5650a
5602
FREQUENCY
AMPLITUDE
n/Ts
3/Ts
2/Ts
1/Ts

FIG.56B

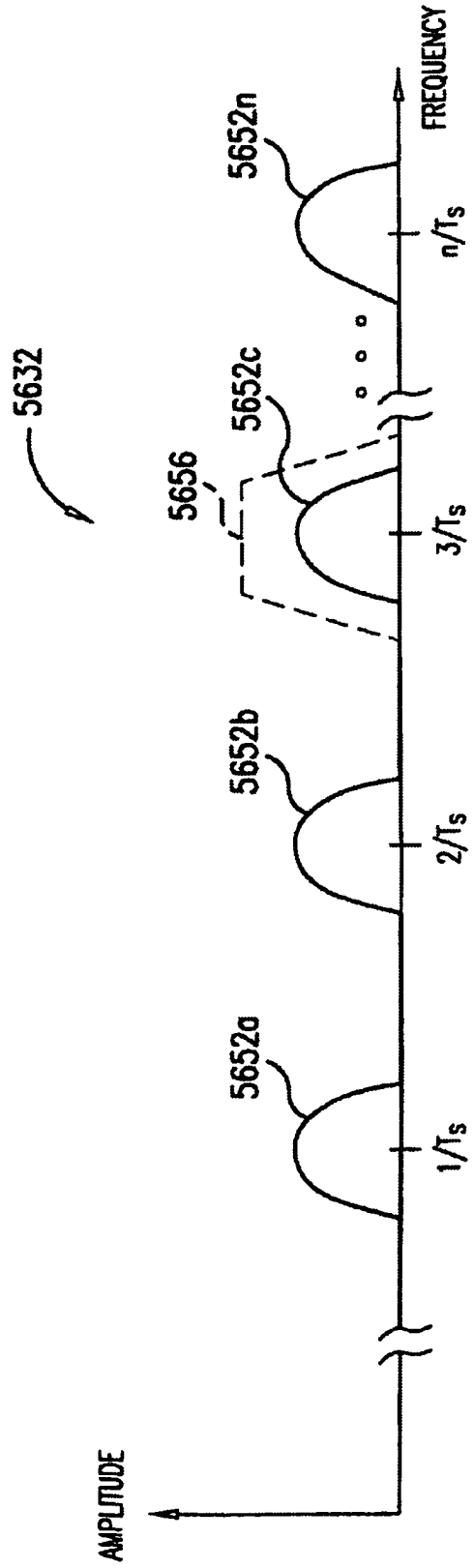

5632
5652n
5652c
5656
5652b
5652a
FREQUENCY
AMPLITUDE
n/Ts
3/Ts
2/Ts
1/Ts

FIG.56C

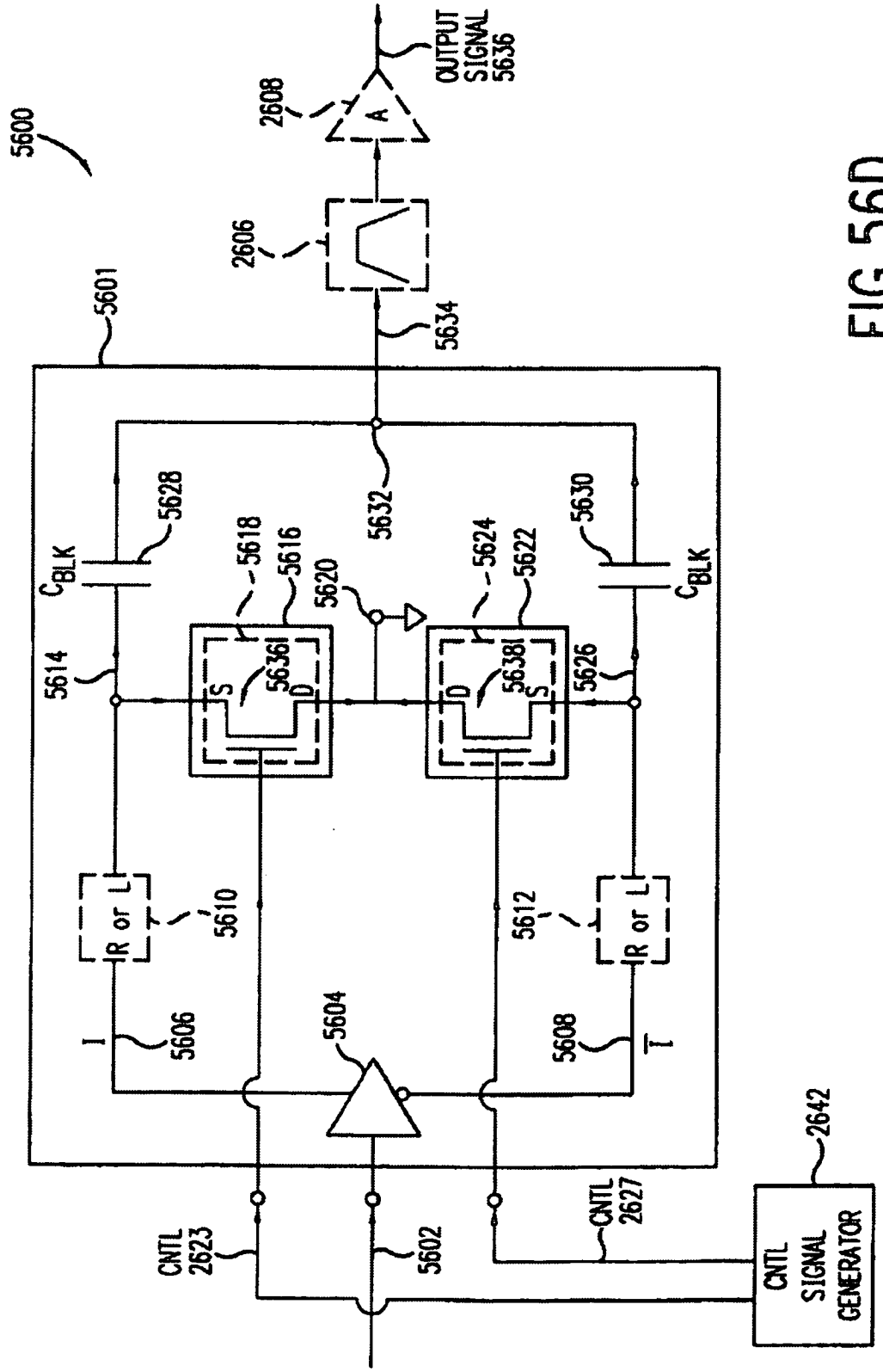

5600
2608
A
OUTPUT SIGNAL 5636
2606
5601
5634
5632
5628
5618
5616
5620
5624
5622
5630
C_{BLK}
C_{BLK}
5614
S
D
56361
56381
D
S
5626
R or L
5610
5612
R or L
I
5606
5604
5608
$\overline{I}$
2642
CNTL 2623
5602
CNTL 2627
CNTL SIGNAL GENERATOR

FIG.56D

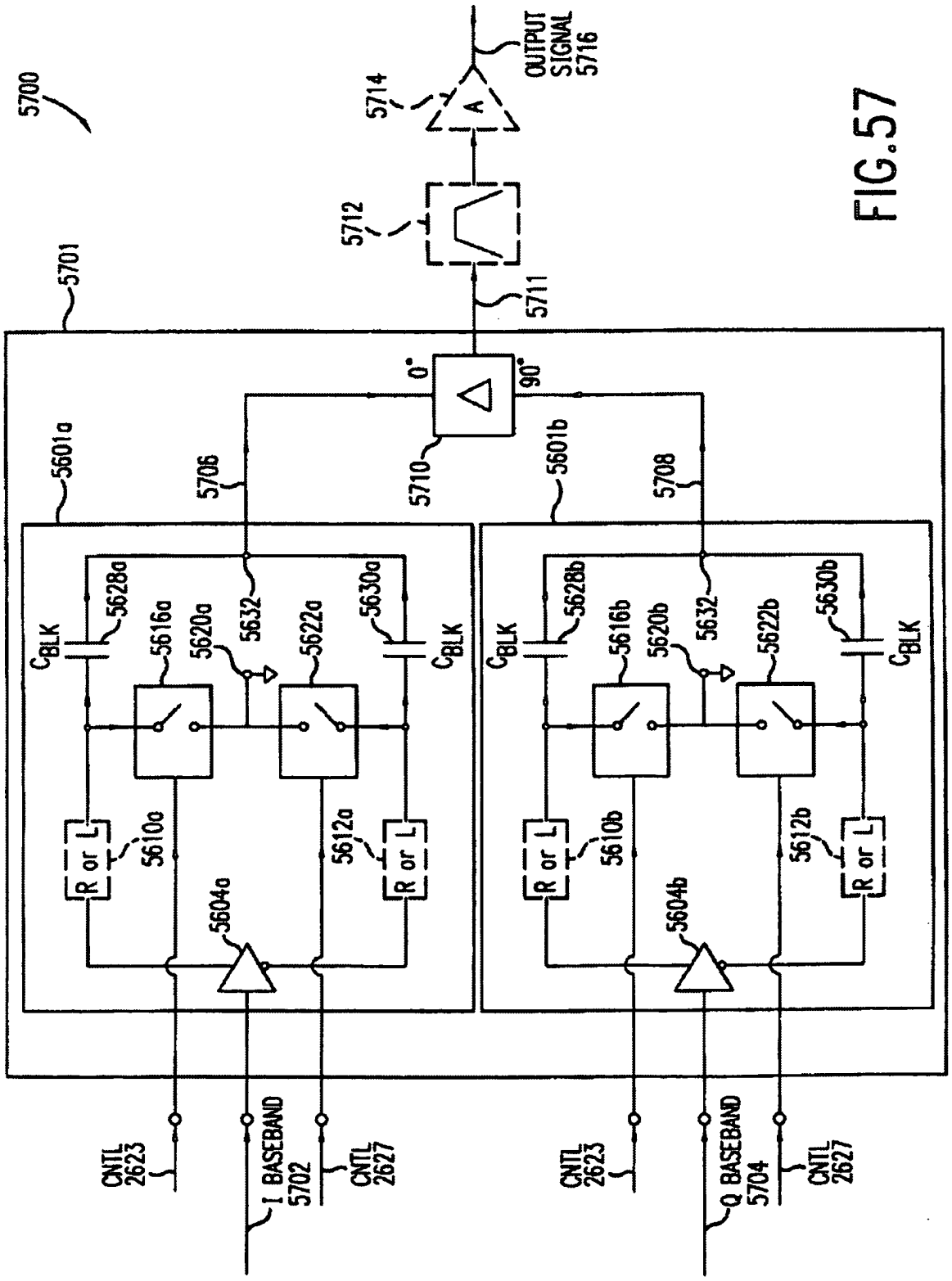

5700
5714
OUTPUT SIGNAL 5716
5712
5711
5701
0°
90°
5710
5601a
5706
5601b
5708
5628a
5616a
5620a
5632
5622a
5630a
C_{BLK}
5610a
5612a
R or L
5604a
5628b
5616b
5620b
5632
5622b
5630b
5610b
5612b
5604b
CNTL 2623
I BASEBAND 5702
CNTL 2627
CNTL 2623
Q BASEBAND 5704
CNTL 2627

FIG.57

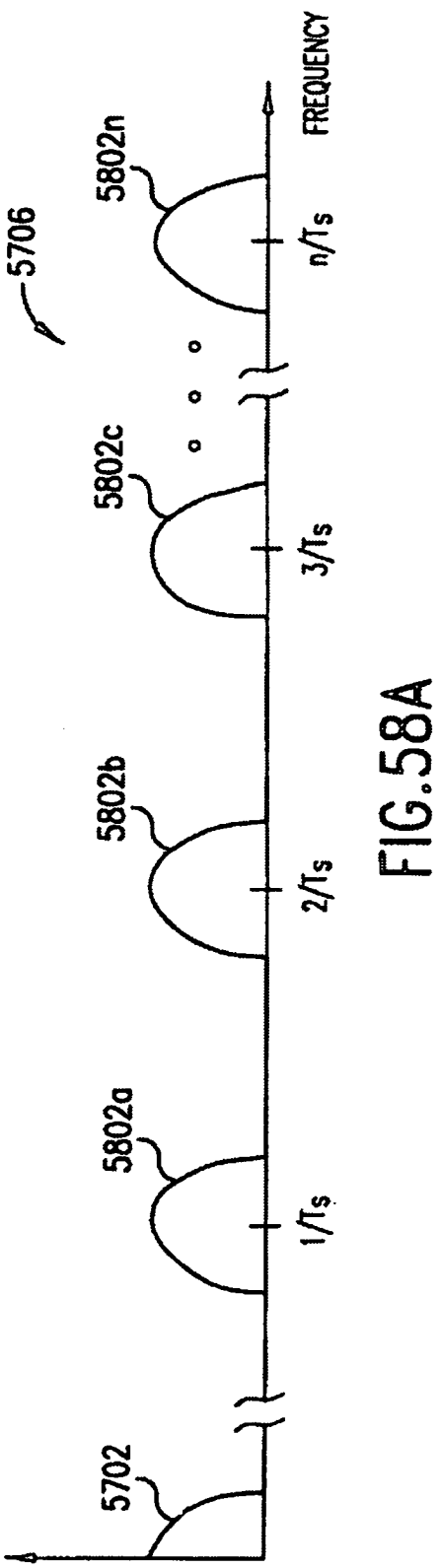


FIG.58A

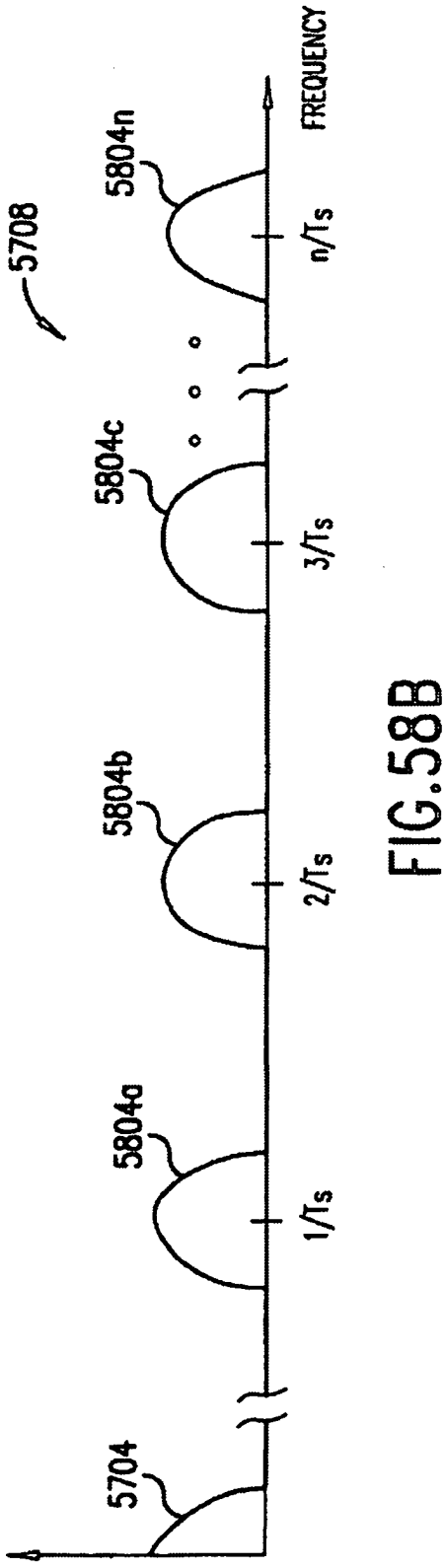


FIG.58B

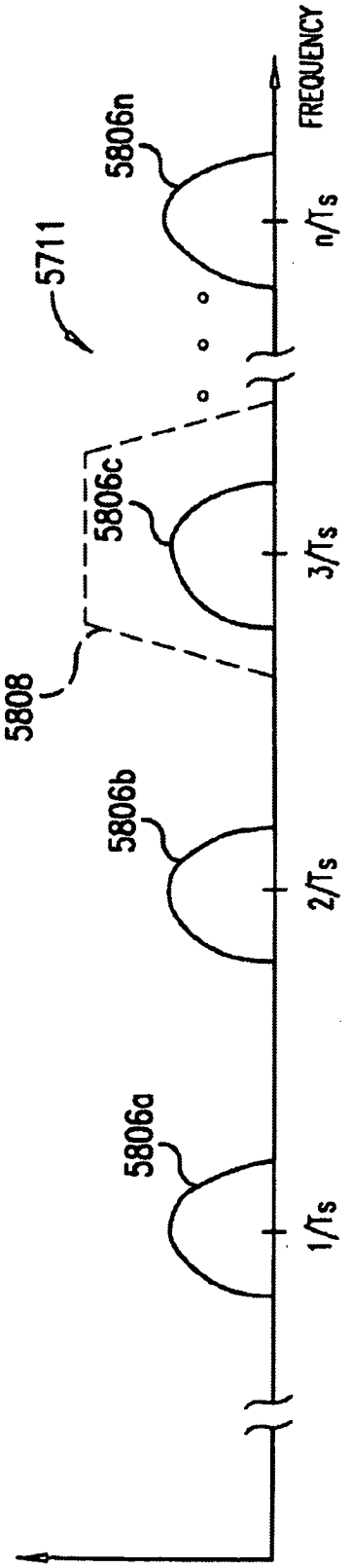


FIG.58C

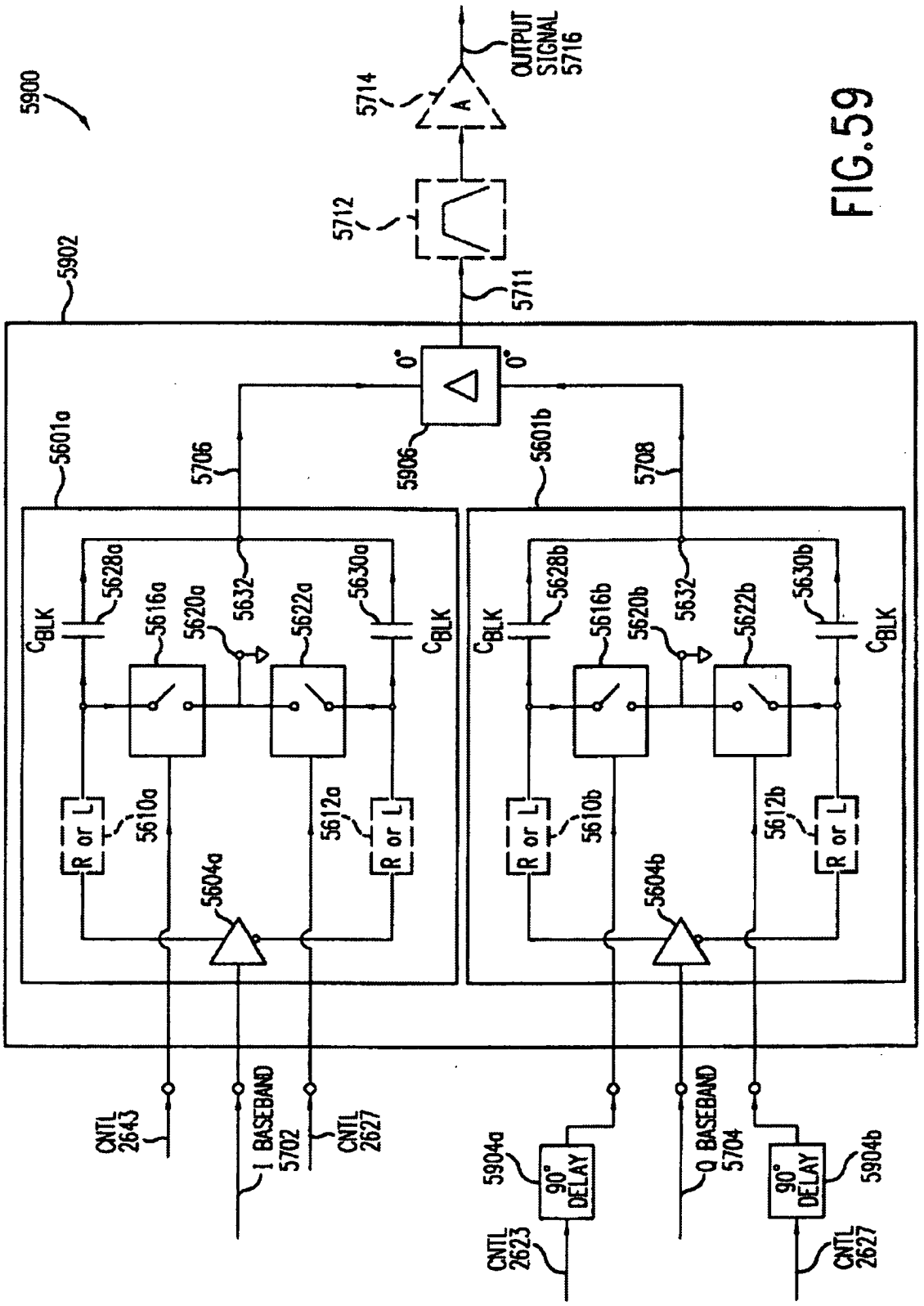

5900
5714
OUTPUT SIGNAL 5716
5712
5711
5902
0°
0°
5906
5601a
5706
5601b
5708
5628a
5616a
5620a
5632
5622a
5630a
C BLK
C BLK
5610a
5612a
R or L
R or L
5604a
5628b
5616b
5620b
5632
5622b
5630b
C BLK
C BLK
5610b
5612b
R or L
R or L
5604b
CNTL 2643
I BASEBAND 5702
CNTL 2627
Q BASEBAND 5704
5904a
90° DELAY
CNTL 2623
90° DELAY
5904b
CNTL 2627

FIG.59

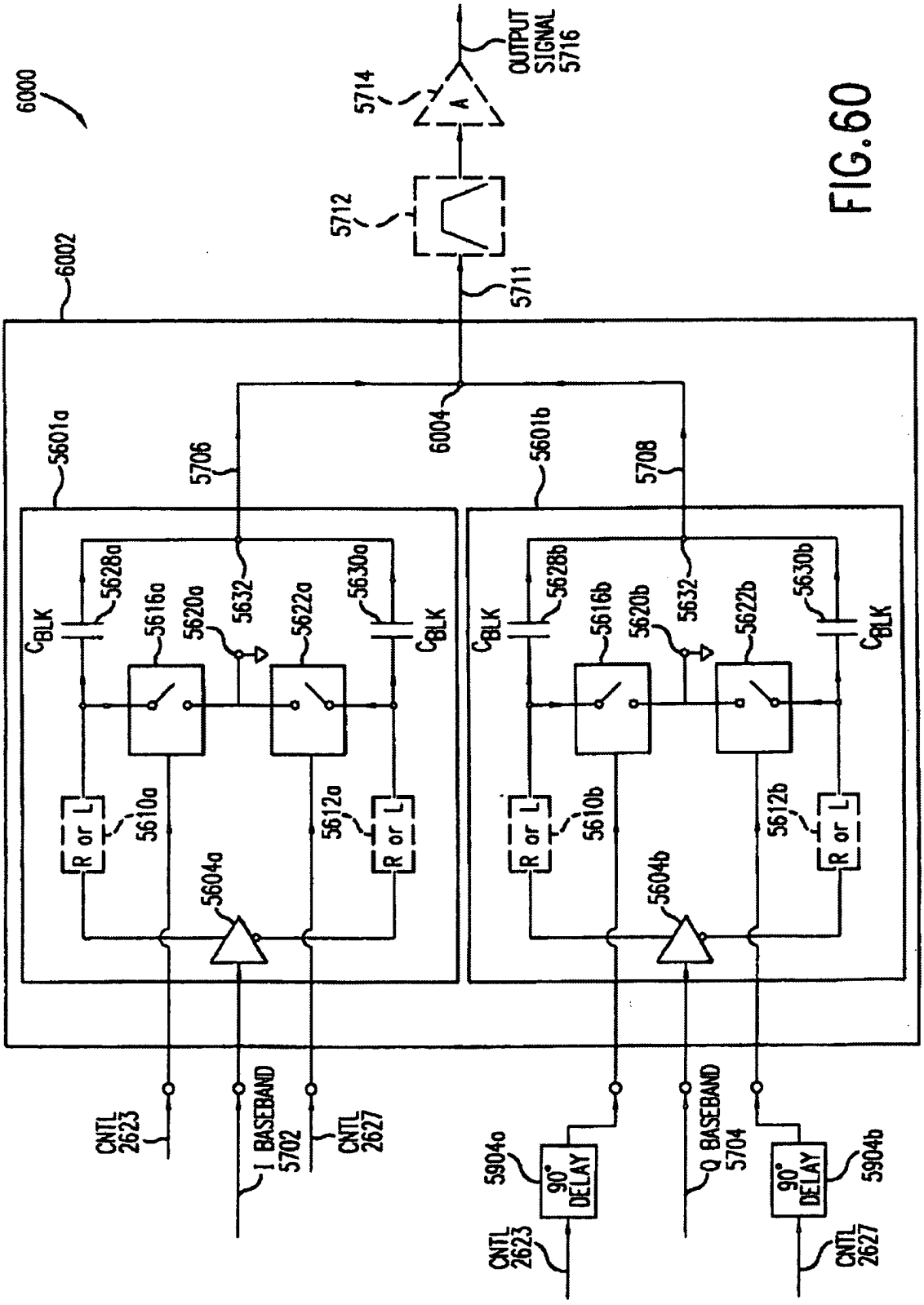

6000
5714
OUTPUT SIGNAL 5716
5712
6002
5711
6004
5601a
5706
5601b
5708
5628a
5616a
5620a
5632
5622a
5630a
C_{BLK}
5610a
5612a
R or L
5604a
5628b
5616b
5620b
5632
5622b
5630b
5610b
5612b
5604b
CNTL 2623
I BASEBAND 5702
CNTL 2627
Q BASEBAND 5704
5904a
5904b
90° DELAY

FIG.60

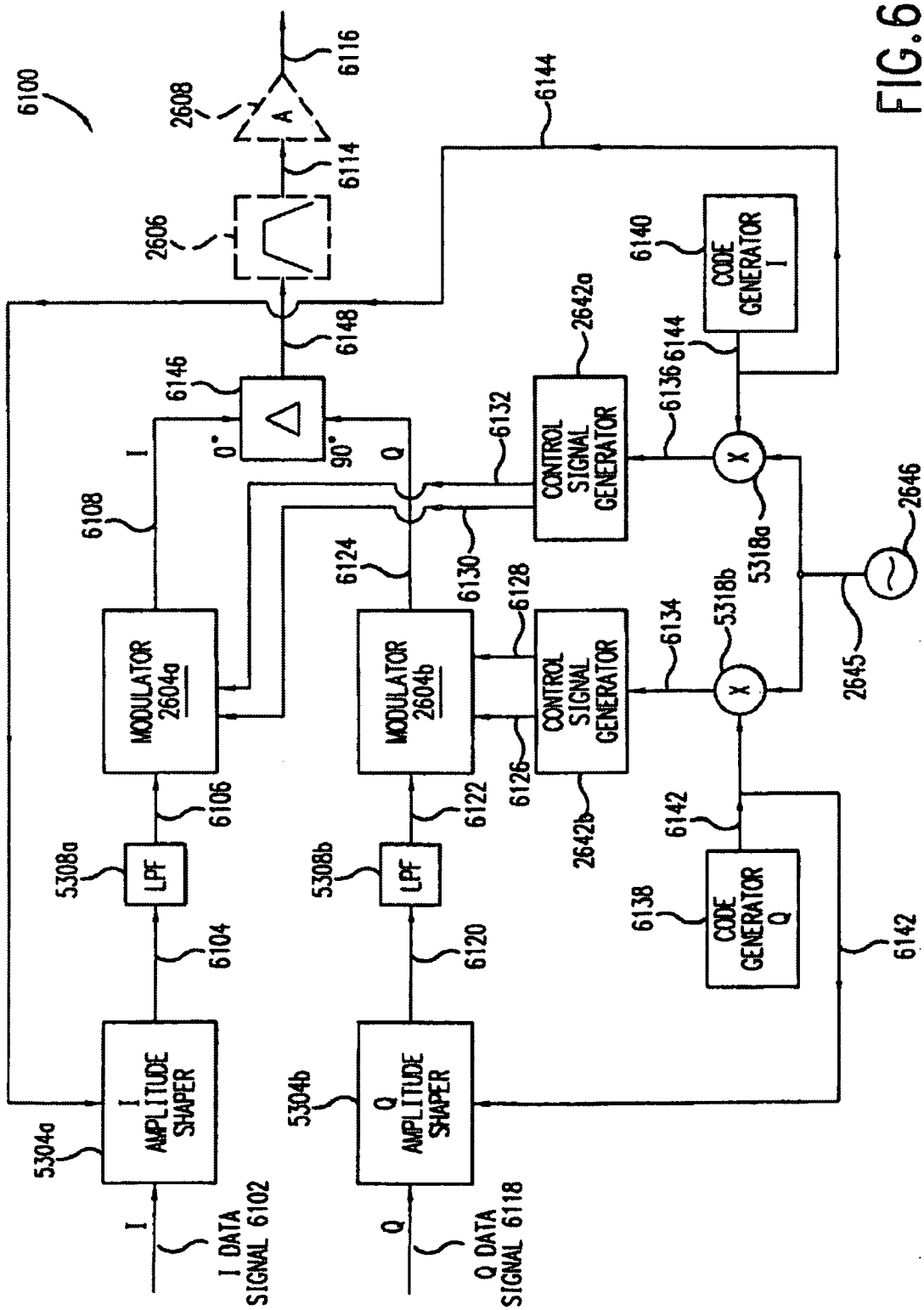

6100
2608
A
6116
6114
6144
2606
6140
CODE GENERATOR I
6148
2642a
6146
6144
6136
6132
0°
90°
I
Q
CONTROL SIGNAL GENERATOR
X
6108
6124
6130
6128
5318a
2646
MODULATOR 2604a
MODULATOR 2604b
CONTROL SIGNAL GENERATOR
6134
5318b
2645
6106
6122
6126
2642b
6142
5308a
5308b
LPF
LPF
6138
CODE GENERATOR Q
6104
6120
6142
5304a
5304b
I AMPLITUDE SHAPER
Q AMPLITUDE SHAPER
I
Q
I DATA SIGNAL 6102
Q DATA SIGNAL 6118

FIG.61

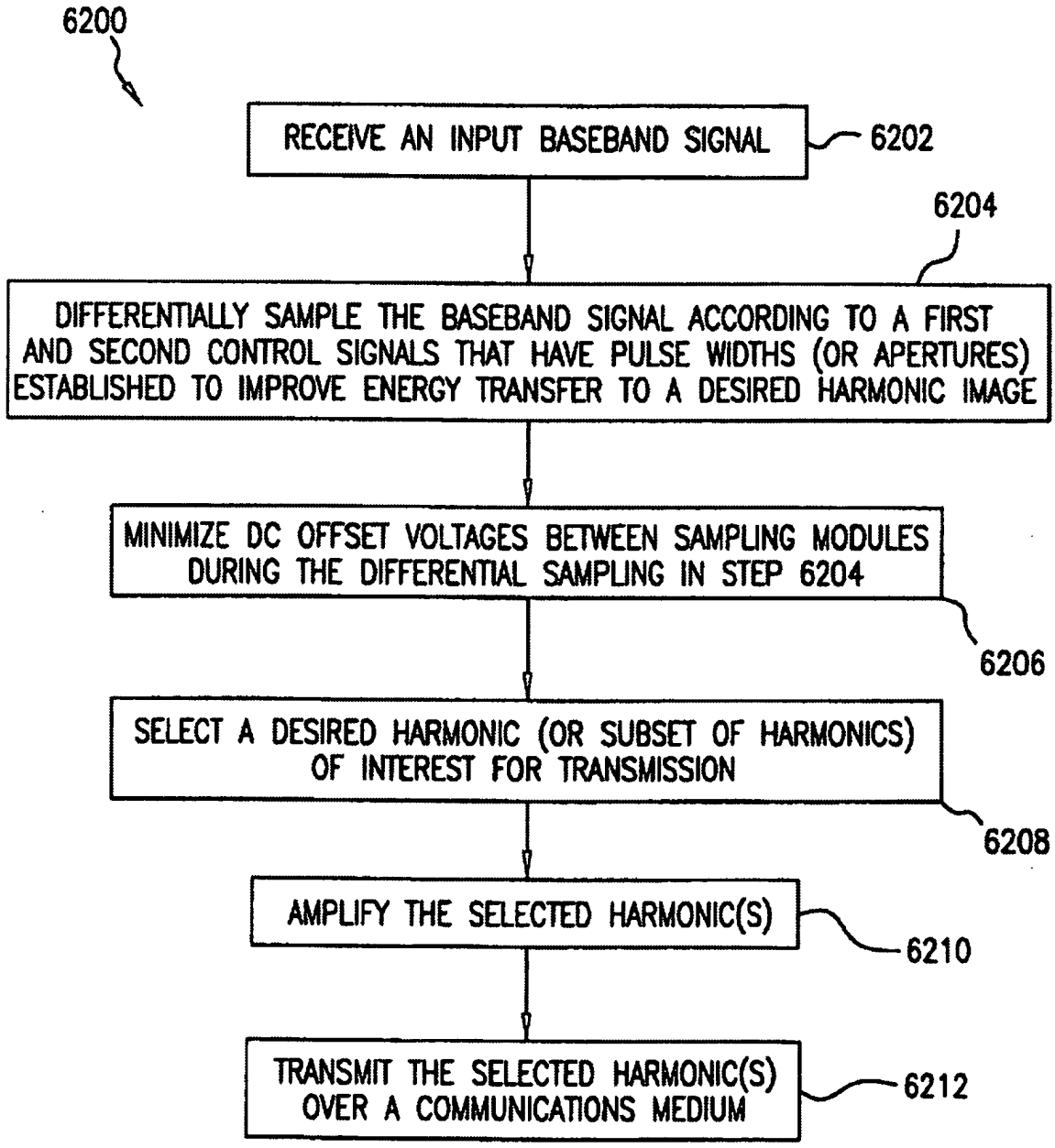

6200
RECEIVE AN INPUT BASEBAND SIGNAL
6202
6204
DIFFERENTIALLY SAMPLE THE BASEBAND SIGNAL ACCORDING TO A FIRST AND SECOND CONTROL SIGNALS THAT HAVE PULSE WIDTHS (OR APERTURES) ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE
MINIMIZE DC OFFSET VOLTAGES BETWEEN SAMPLING MODULES DURING THE DIFFERENTIAL SAMPLING IN STEP 6204
6206
SELECT A DESIRED HARMONIC (OR SUBSET OF HARMONICS) OF INTEREST FOR TRANSMISSION
6208
AMPLIFY THE SELECTED HARMONIC(S)
6210
TRANSMIT THE SELECTED HARMONIC(S) OVER A COMMUNICATIONS MEDIUM
6212

FIG.62

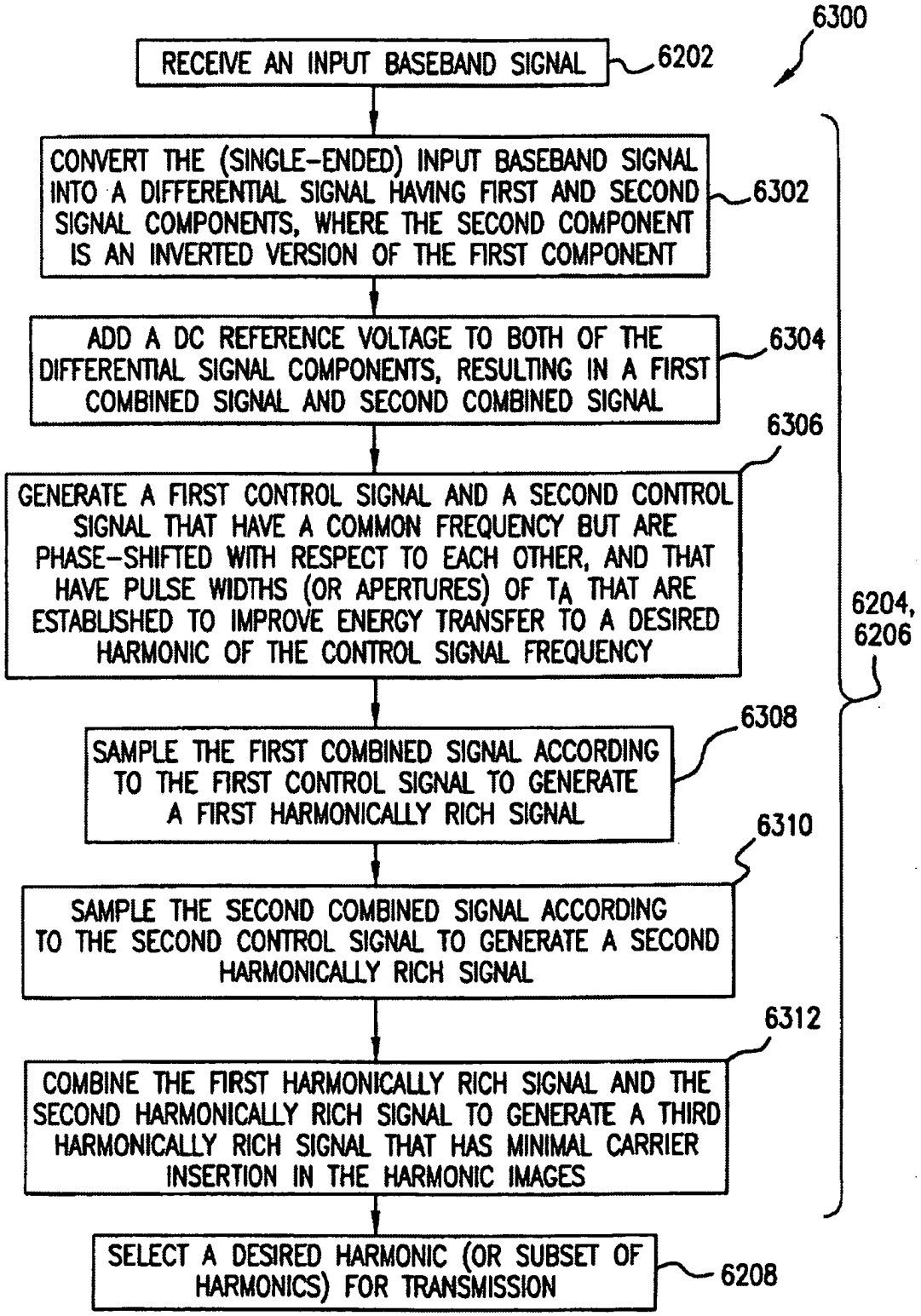

6300
RECEIVE AN INPUT BASEBAND SIGNAL
6202
CONVERT THE (SINGLE-ENDED) INPUT BASEBAND SIGNAL INTO A DIFFERENTIAL SIGNAL HAVING FIRST AND SECOND SIGNAL COMPONENTS, WHERE THE SECOND COMPONENT IS AN INVERTED VERSION OF THE FIRST COMPONENT
6302
ADD A DC REFERENCE VOLTAGE TO BOTH OF THE DIFFERENTIAL SIGNAL COMPONENTS, RESULTING IN A FIRST COMBINED SIGNAL AND SECOND COMBINED SIGNAL
6304
6306
GENERATE A FIRST CONTROL SIGNAL AND A SECOND CONTROL SIGNAL THAT HAVE A COMMON FREQUENCY BUT ARE PHASE-SHIFTED WITH RESPECT TO EACH OTHER, AND THAT HAVE PULSE WIDTHS (OR APERTURES) OF T_A THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC OF THE CONTROL SIGNAL FREQUENCY
6204, 6206
SAMPLE THE FIRST COMBINED SIGNAL ACCORDING TO THE FIRST CONTROL SIGNAL TO GENERATE A FIRST HARMONICALLY RICH SIGNAL
6308
6310
SAMPLE THE SECOND COMBINED SIGNAL ACCORDING TO THE SECOND CONTROL SIGNAL TO GENERATE A SECOND HARMONICALLY RICH SIGNAL
6312
COMBINE THE FIRST HARMONICALLY RICH SIGNAL AND THE SECOND HARMONICALLY RICH SIGNAL TO GENERATE A THIRD HARMONICALLY RICH SIGNAL THAT HAS MINIMAL CARRIER INSERTION IN THE HARMONIC IMAGES
SELECT A DESIRED HARMONIC (OR SUBSET OF HARMONICS) FOR TRANSMISSION
6208

FIG.63

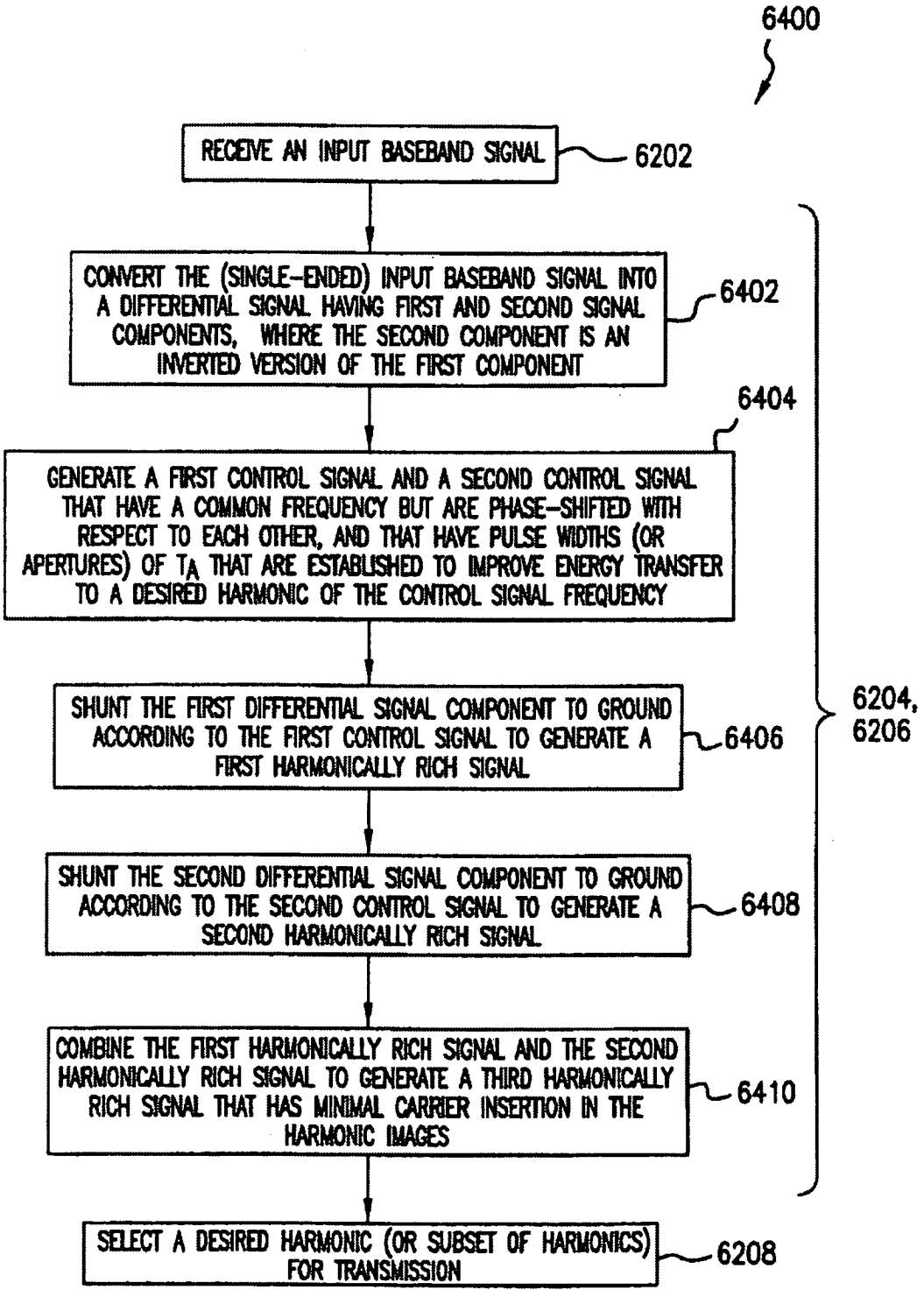

6400
RECEIVE AN INPUT BASEBAND SIGNAL
6202
CONVERT THE (SINGLE-ENDED) INPUT BASEBAND SIGNAL INTO A DIFFERENTIAL SIGNAL HAVING FIRST AND SECOND SIGNAL COMPONENTS, WHERE THE SECOND COMPONENT IS AN INVERTED VERSION OF THE FIRST COMPONENT
6402
6404
GENERATE A FIRST CONTROL SIGNAL AND A SECOND CONTROL SIGNAL THAT HAVE A COMMON FREQUENCY BUT ARE PHASE-SHIFTED WITH RESPECT TO EACH OTHER, AND THAT HAVE PULSE WIDTHS (OR APERTURES) OF T_A THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC OF THE CONTROL SIGNAL FREQUENCY
SHUNT THE FIRST DIFFERENTIAL SIGNAL COMPONENT TO GROUND ACCORDING TO THE FIRST CONTROL SIGNAL TO GENERATE A FIRST HARMONICALLY RICH SIGNAL
6406
6204, 6206
SHUNT THE SECOND DIFFERENTIAL SIGNAL COMPONENT TO GROUND ACCORDING TO THE SECOND CONTROL SIGNAL TO GENERATE A SECOND HARMONICALLY RICH SIGNAL
6408
COMBINE THE FIRST HARMONICALLY RICH SIGNAL AND THE SECOND HARMONICALLY RICH SIGNAL TO GENERATE A THIRD HARMONICALLY RICH SIGNAL THAT HAS MINIMAL CARRIER INSERTION IN THE HARMONIC IMAGES
6410
SELECT A DESIRED HARMONIC (OR SUBSET OF HARMONICS) FOR TRANSMISSION
6208

FIG.64

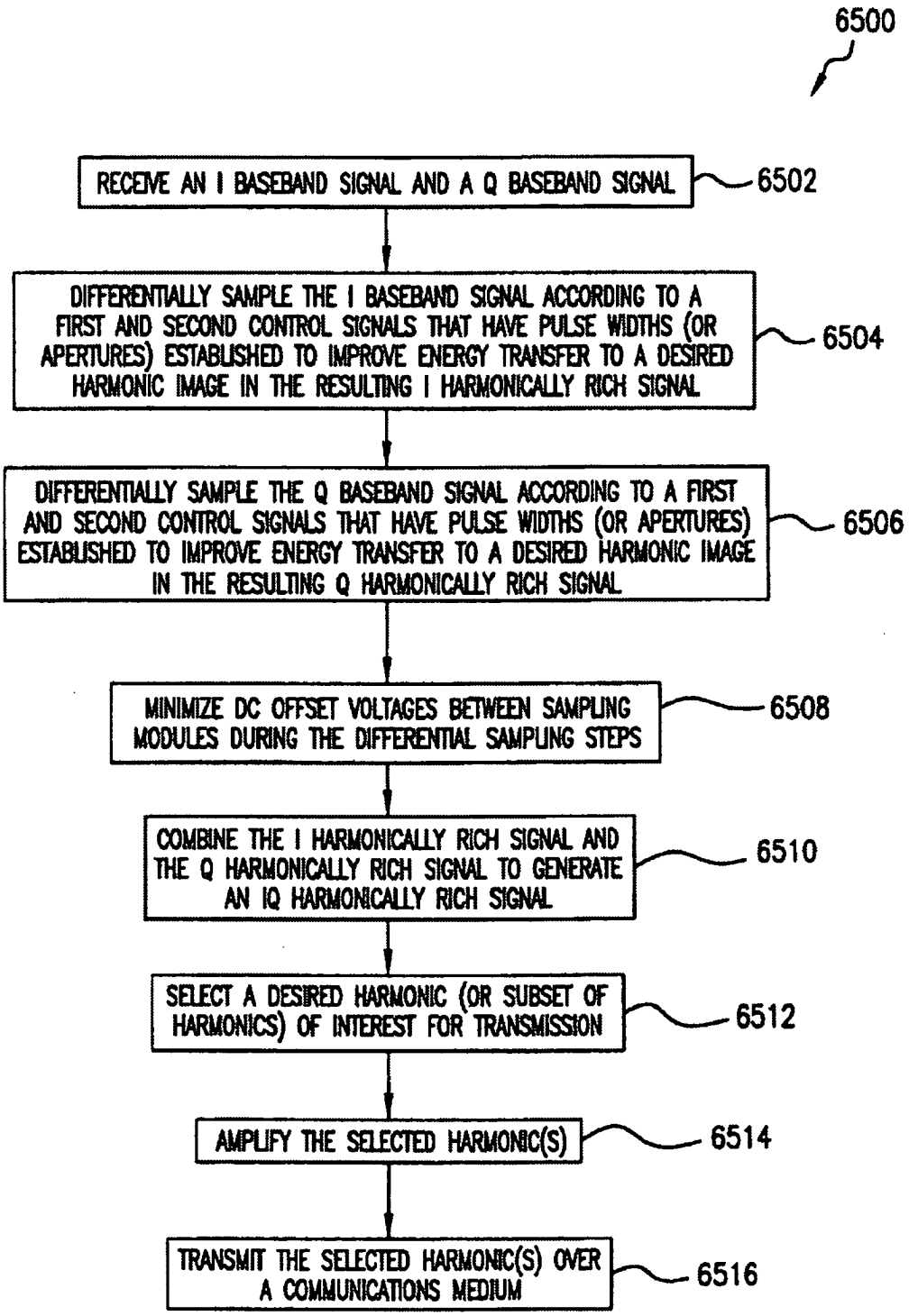

6500
RECEIVE AN I BASEBAND SIGNAL AND A Q BASEBAND SIGNAL
6502
DIFFERENTIALLY SAMPLE THE I BASEBAND SIGNAL ACCORDING TO A FIRST AND SECOND CONTROL SIGNALS THAT HAVE PULSE WIDTHS (OR APERTURES) ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE IN THE RESULTING I HARMONICALLY RICH SIGNAL
6504
DIFFERENTIALLY SAMPLE THE Q BASEBAND SIGNAL ACCORDING TO A FIRST AND SECOND CONTROL SIGNALS THAT HAVE PULSE WIDTHS (OR APERTURES) ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE IN THE RESULTING Q HARMONICALLY RICH SIGNAL
6506
MINIMIZE DC OFFSET VOLTAGES BETWEEN SAMPLING MODULES DURING THE DIFFERENTIAL SAMPLING STEPS
6508
COMBINE THE I HARMONICALLY RICH SIGNAL AND THE Q HARMONICALLY RICH SIGNAL TO GENERATE AN IQ HARMONICALLY RICH SIGNAL
6510
SELECT A DESIRED HARMONIC (OR SUBSET OF HARMONICS) OF INTEREST FOR TRANSMISSION
6512
AMPLIFY THE SELECTED HARMONIC(S)
6514
TRANSMIT THE SELECTED HARMONIC(S) OVER A COMMUNICATIONS MEDIUM
6516

FIG.65

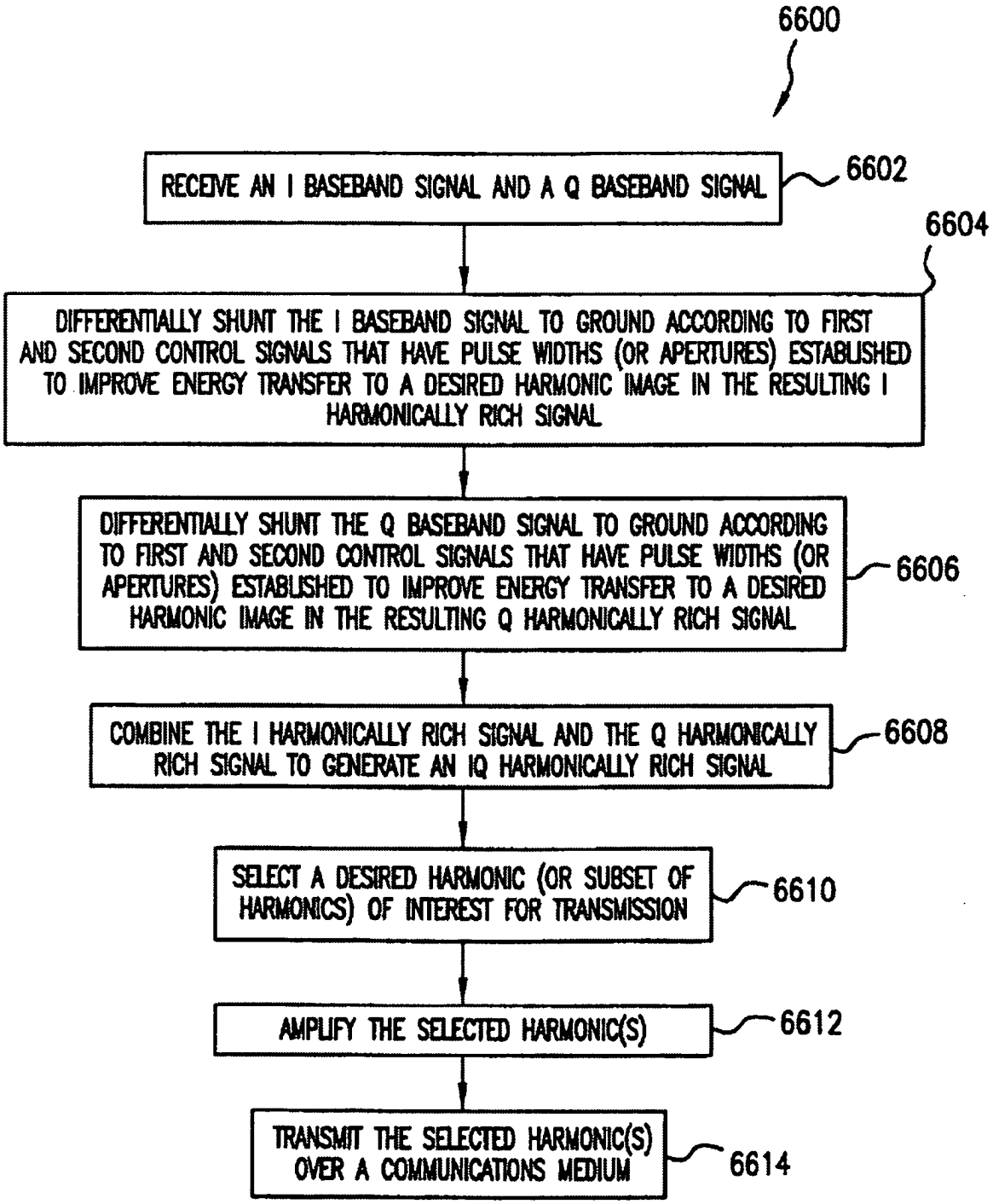

6600
RECEIVE AN I BASEBAND SIGNAL AND A Q BASEBAND SIGNAL
6602
6604
DIFFERENTIALLY SHUNT THE I BASEBAND SIGNAL TO GROUND ACCORDING TO FIRST AND SECOND CONTROL SIGNALS THAT HAVE PULSE WIDTHS (OR APERTURES) ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE IN THE RESULTING I HARMONICALLY RICH SIGNAL
DIFFERENTIALLY SHUNT THE Q BASEBAND SIGNAL TO GROUND ACCORDING TO FIRST AND SECOND CONTROL SIGNALS THAT HAVE PULSE WIDTHS (OR APERTURES) ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE IN THE RESULTING Q HARMONICALLY RICH SIGNAL
6606
COMBINE THE I HARMONICALLY RICH SIGNAL AND THE Q HARMONICALLY RICH SIGNAL TO GENERATE AN IQ HARMONICALLY RICH SIGNAL
6608
SELECT A DESIRED HARMONIC (OR SUBSET OF HARMONICS) OF INTEREST FOR TRANSMISSION
6610
AMPLIFY THE SELECTED HARMONIC(S)
6612
TRANSMIT THE SELECTED HARMONIC(S) OVER A COMMUNICATIONS MEDIUM
6614

FIG.66

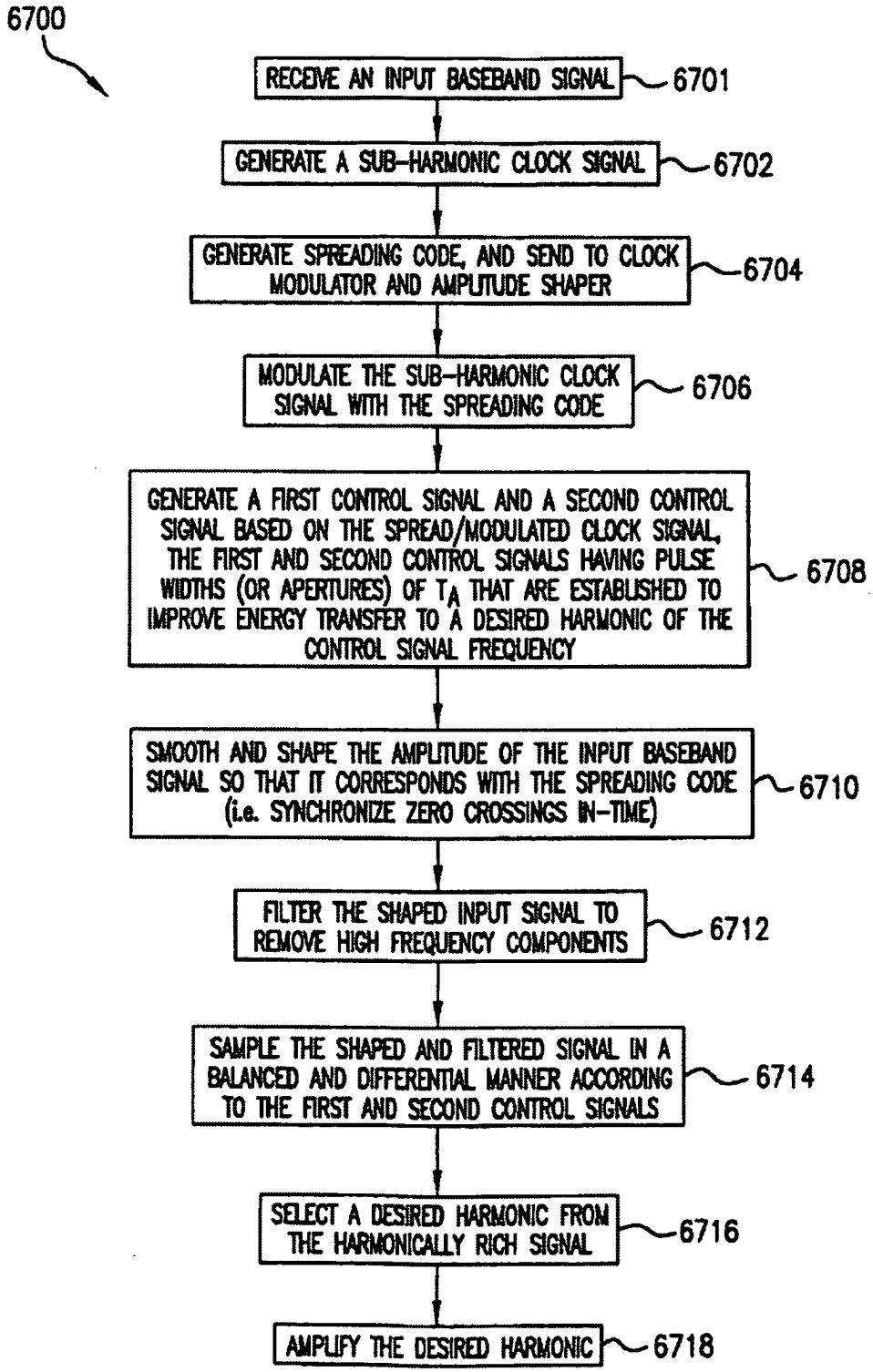

6700
RECEIVE AN INPUT BASEBAND SIGNAL
6701
GENERATE A SUB-HARMONIC CLOCK SIGNAL
6702
GENERATE SPREADING CODE, AND SEND TO CLOCK MODULATOR AND AMPLITUDE SHAPER
6704
MODULATE THE SUB-HARMONIC CLOCK SIGNAL WITH THE SPREADING CODE
6706
GENERATE A FIRST CONTROL SIGNAL AND A SECOND CONTROL SIGNAL BASED ON THE SPREAD/MODULATED CLOCK SIGNAL, THE FIRST AND SECOND CONTROL SIGNALS HAVING PULSE WIDTHS (OR APERTURES) OF T_A THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC OF THE CONTROL SIGNAL FREQUENCY
6708
SMOOTH AND SHAPE THE AMPLITUDE OF THE INPUT BASEBAND SIGNAL SO THAT IT CORRESPONDS WITH THE SPREADING CODE (i.e. SYNCHRONIZE ZERO CROSSINGS IN-TIME)
6710
FILTER THE SHAPED INPUT SIGNAL TO REMOVE HIGH FREQUENCY COMPONENTS
6712
SAMPLE THE SHAPED AND FILTERED SIGNAL IN A BALANCED AND DIFFERENTIAL MANNER ACCORDING TO THE FIRST AND SECOND CONTROL SIGNALS
6714
SELECT A DESIRED HARMONIC FROM THE HARMONICALLY RICH SIGNAL
6716
AMPLIFY THE DESIRED HARMONIC
6718

FIG.67

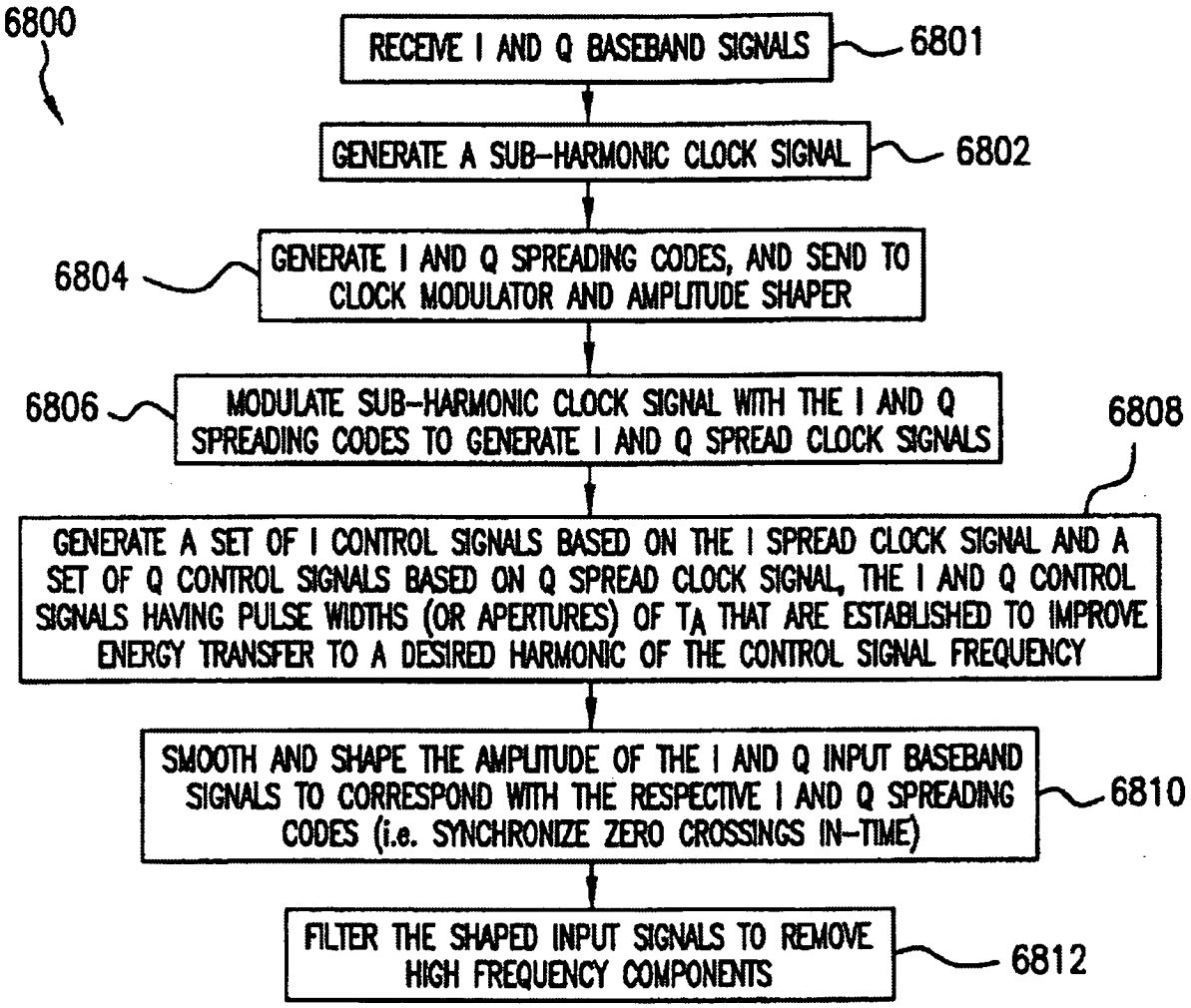

6800
RECEIVE I AND Q BASEBAND SIGNALS
6801
GENERATE A SUB-HARMONIC CLOCK SIGNAL
6802
6804
GENERATE I AND Q SPREADING CODES, AND SEND TO CLOCK MODULATOR AND AMPLITUDE SHAPER
6806
MODULATE SUB-HARMONIC CLOCK SIGNAL WITH THE I AND Q SPREADING CODES TO GENERATE I AND Q SPREAD CLOCK SIGNALS
6808
GENERATE A SET OF I CONTROL SIGNALS BASED ON THE I SPREAD CLOCK SIGNAL AND A SET OF Q CONTROL SIGNALS BASED ON Q SPREAD CLOCK SIGNAL, THE I AND Q CONTROL SIGNALS HAVING PULSE WIDTHS (OR APERTURES) OF T_A THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC OF THE CONTROL SIGNAL FREQUENCY
SMOOTH AND SHAPE THE AMPLITUDE OF THE I AND Q INPUT BASEBAND SIGNALS TO CORRESPOND WITH THE RESPECTIVE I AND Q SPREADING CODES (i.e. SYNCHRONIZE ZERO CROSSINGS IN-TIME)
6810
FILTER THE SHAPED INPUT SIGNALS TO REMOVE HIGH FREQUENCY COMPONENTS
6812

FIG.68A

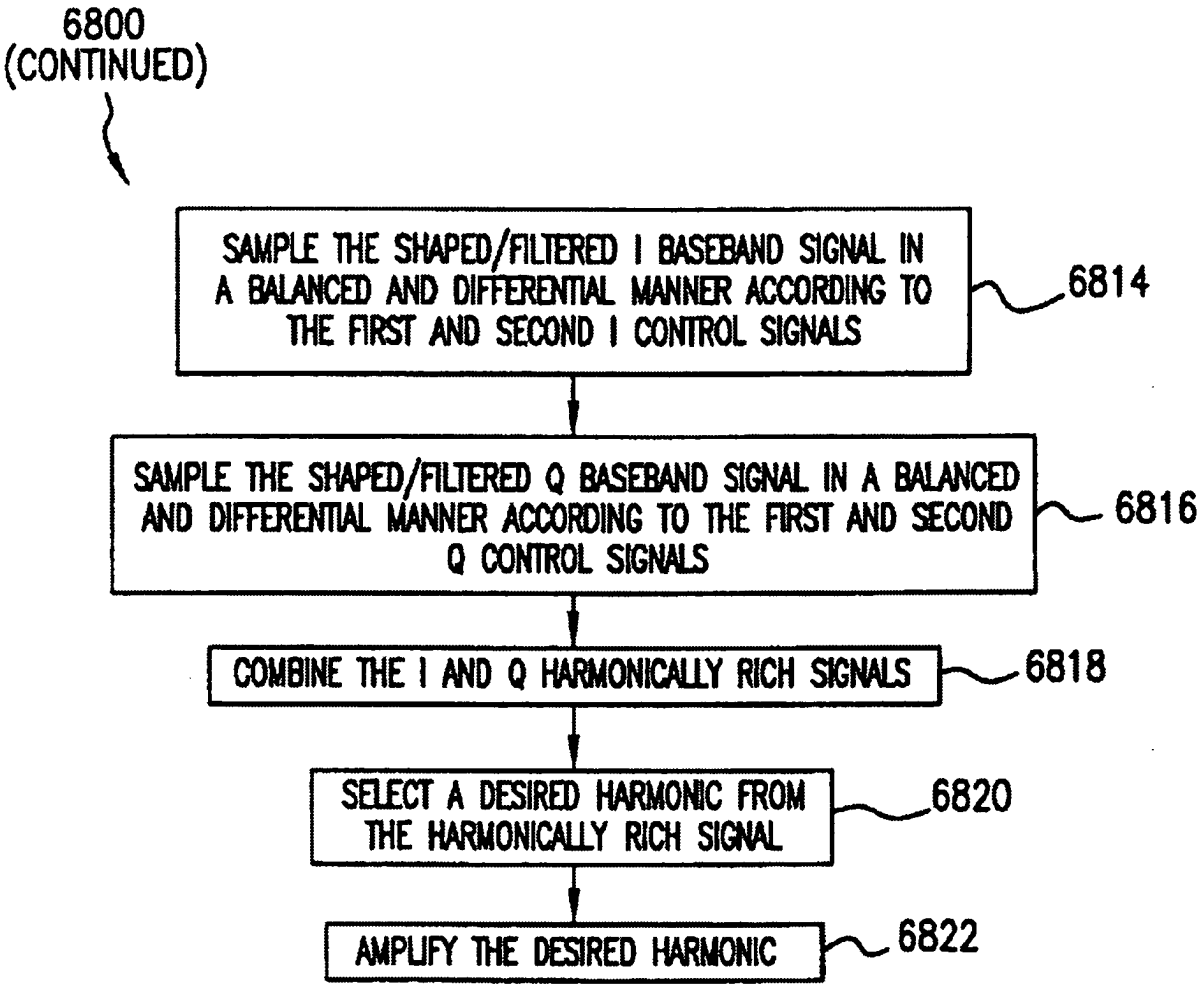

6800
(CONTINUED)
SAMPLE THE SHAPED/FILTERED I BASEBAND SIGNAL IN A BALANCED AND DIFFERENTIAL MANNER ACCORDING TO THE FIRST AND SECOND I CONTROL SIGNALS
6814
SAMPLE THE SHAPED/FILTERED Q BASEBAND SIGNAL IN A BALANCED AND DIFFERENTIAL MANNER ACCORDING TO THE FIRST AND SECOND Q CONTROL SIGNALS
6816
COMBINE THE I AND Q HARMONICALLY RICH SIGNALS
6818
SELECT A DESIRED HARMONIC FROM THE HARMONICALLY RICH SIGNAL
6820
AMPLIFY THE DESIRED HARMONIC
6822

FIG.68B

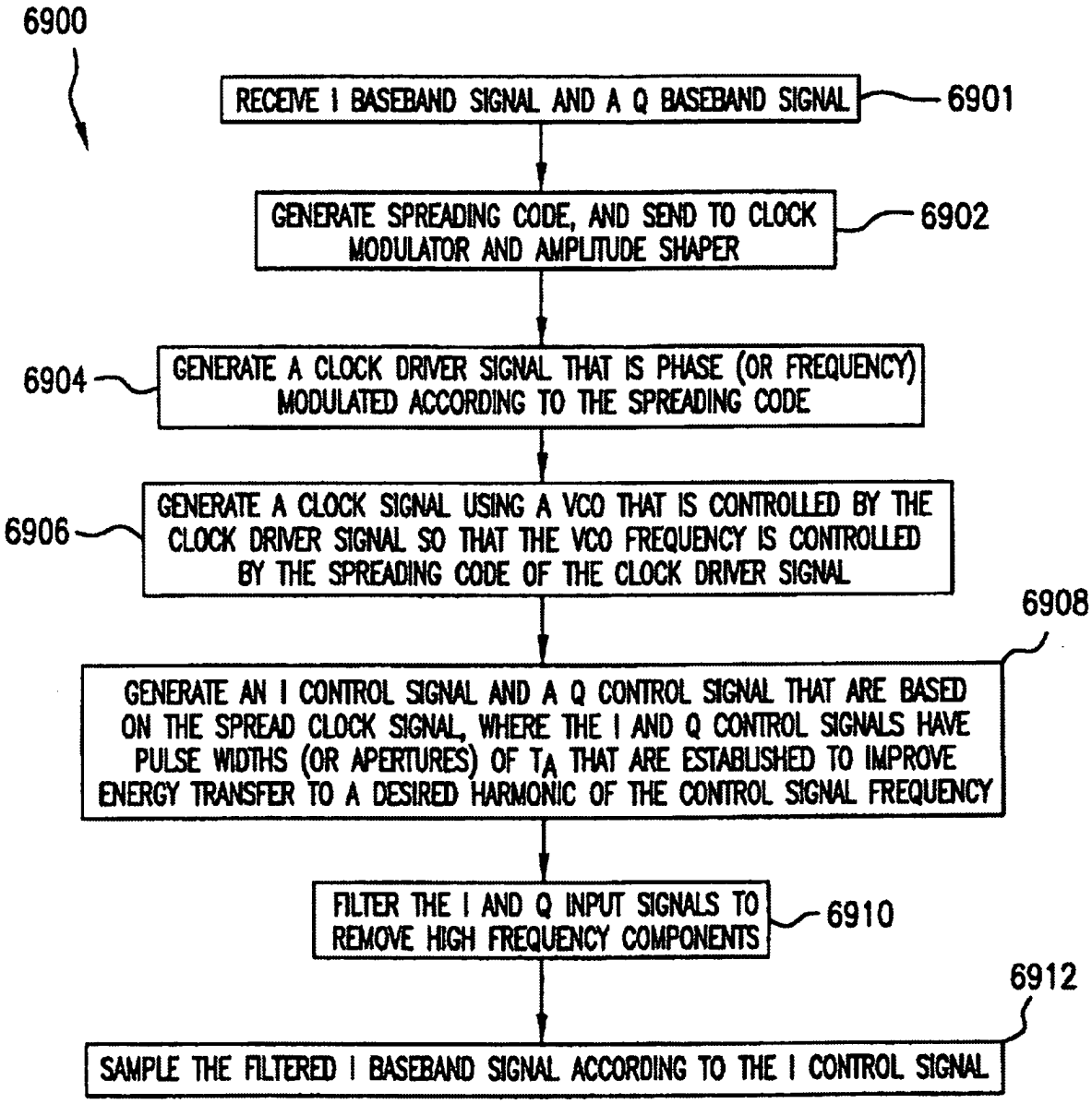

6900
RECEIVE I BASEBAND SIGNAL AND A Q BASEBAND SIGNAL
6901
GENERATE SPREADING CODE, AND SEND TO CLOCK MODULATOR AND AMPLITUDE SHAPER
6902
6904
GENERATE A CLOCK DRIVER SIGNAL THAT IS PHASE (OR FREQUENCY) MODULATED ACCORDING TO THE SPREADING CODE
6906
GENERATE A CLOCK SIGNAL USING A VCO THAT IS CONTROLLED BY THE CLOCK DRIVER SIGNAL SO THAT THE VCO FREQUENCY IS CONTROLLED BY THE SPREADING CODE OF THE CLOCK DRIVER SIGNAL
6908
GENERATE AN I CONTROL SIGNAL AND A Q CONTROL SIGNAL THAT ARE BASED ON THE SPREAD CLOCK SIGNAL, WHERE THE I AND Q CONTROL SIGNALS HAVE PULSE WIDTHS (OR APERTURES) OF T_A THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC OF THE CONTROL SIGNAL FREQUENCY
FILTER THE I AND Q INPUT SIGNALS TO REMOVE HIGH FREQUENCY COMPONENTS
6910
6912
SAMPLE THE FILTERED I BASEBAND SIGNAL ACCORDING TO THE I CONTROL SIGNAL

FIG.69A

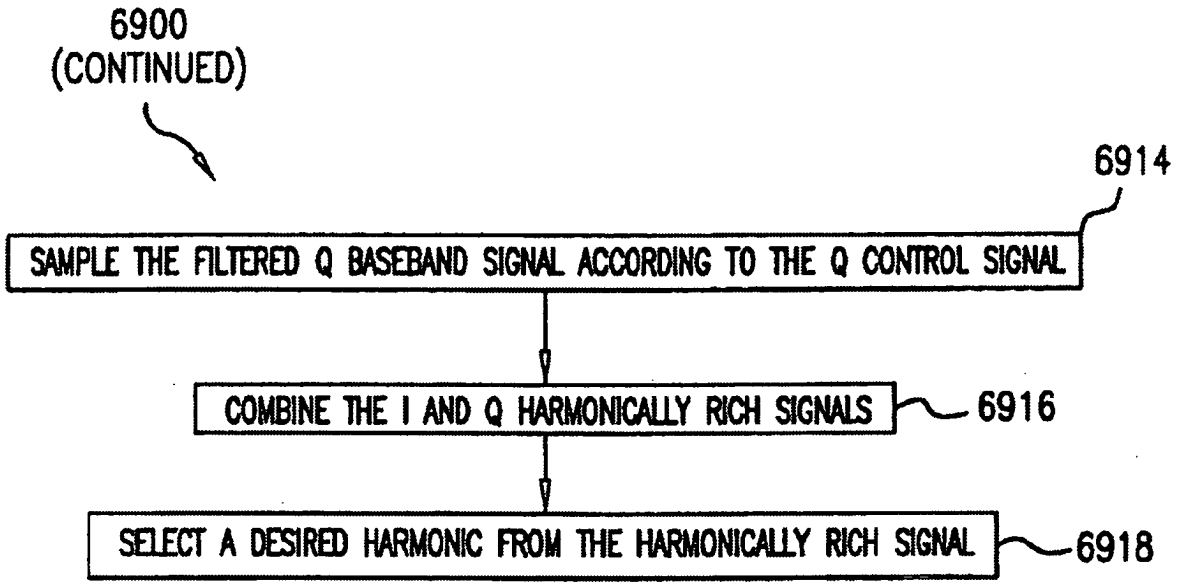

6900
(CONTINUED)
6914
SAMPLE THE FILTERED Q BASEBAND SIGNAL ACCORDING TO THE Q CONTROL SIGNAL
COMBINE THE I AND Q HARMONICALLY RICH SIGNALS
6916
SELECT A DESIRED HARMONIC FROM THE HARMONICALLY RICH SIGNAL
6918

FIG.69B

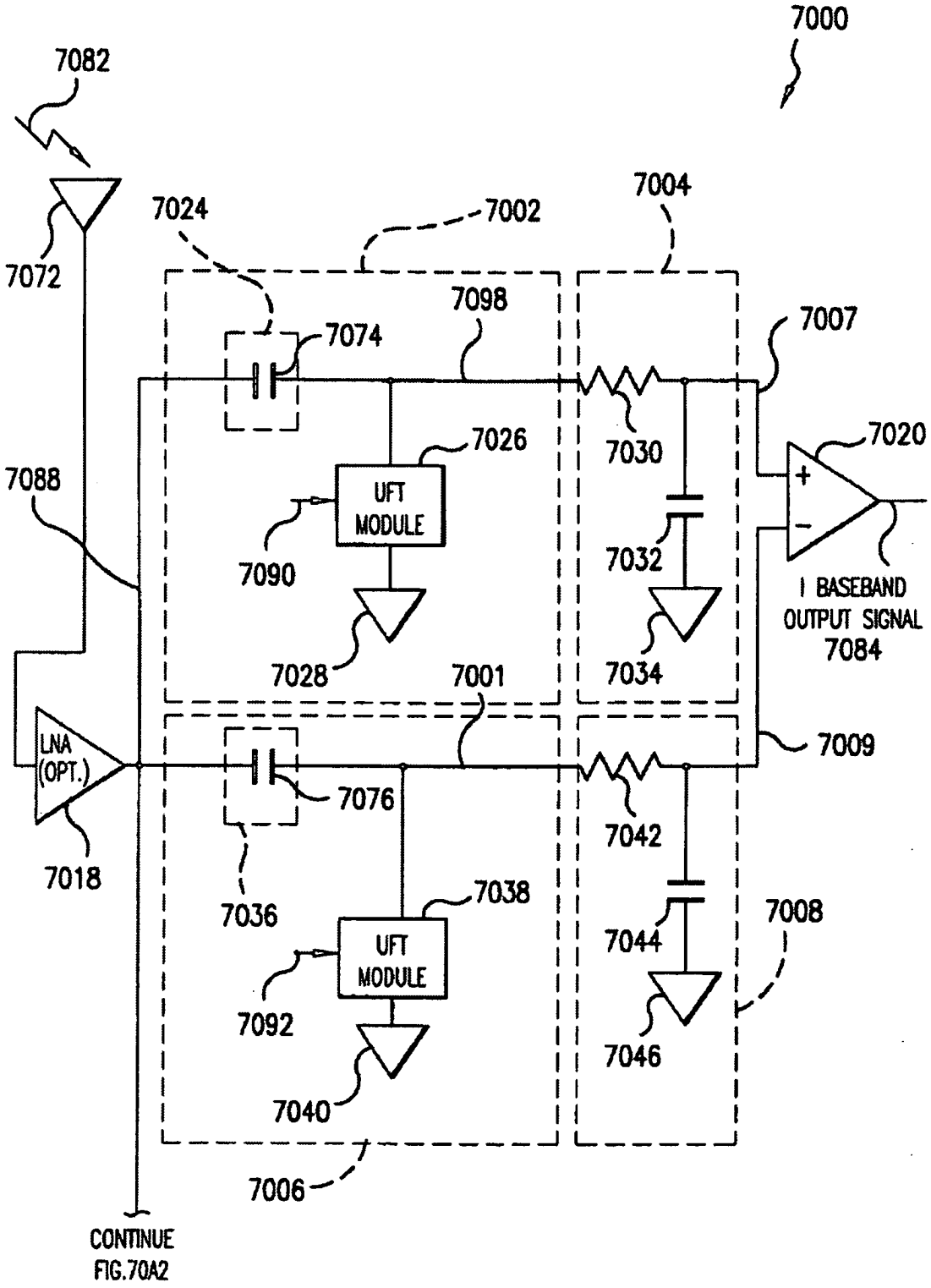

7000
7082
7072
7024
7002
7004
7074
7098
7007
7026
7030
7020
7088
UFT MODULE
7090
7032
I BASEBAND OUTPUT SIGNAL 7084
7028
7001
7034
LNA (OPT.)
7009
7076
7042
7018
7036
7038
7008
UFT MODULE
7044
7092
7046
7040
7006
CONTINUE FIG.70A2

FIG.70A1

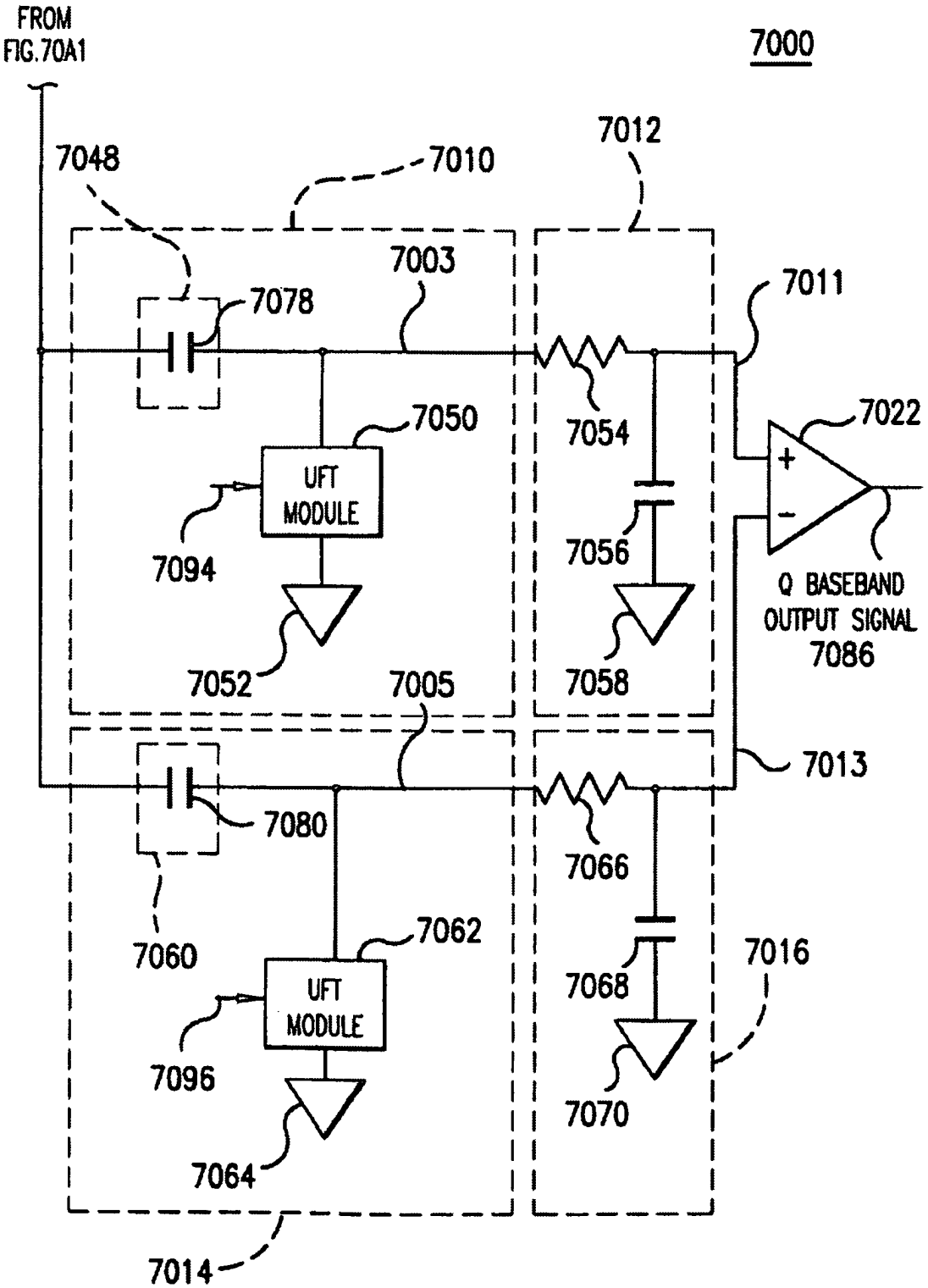

FROM FIG.70A1
7000
7048
7010
7012
7003
7078
7011
7050
7054
7022
UFT MODULE
7094
7056
Q BASEBAND OUTPUT SIGNAL 7086
7052
7005
7058
7013
7080
7066
7062
7060
7016
7068
UFT MODULE
7096
7070
7064
7014

FIG.70A2

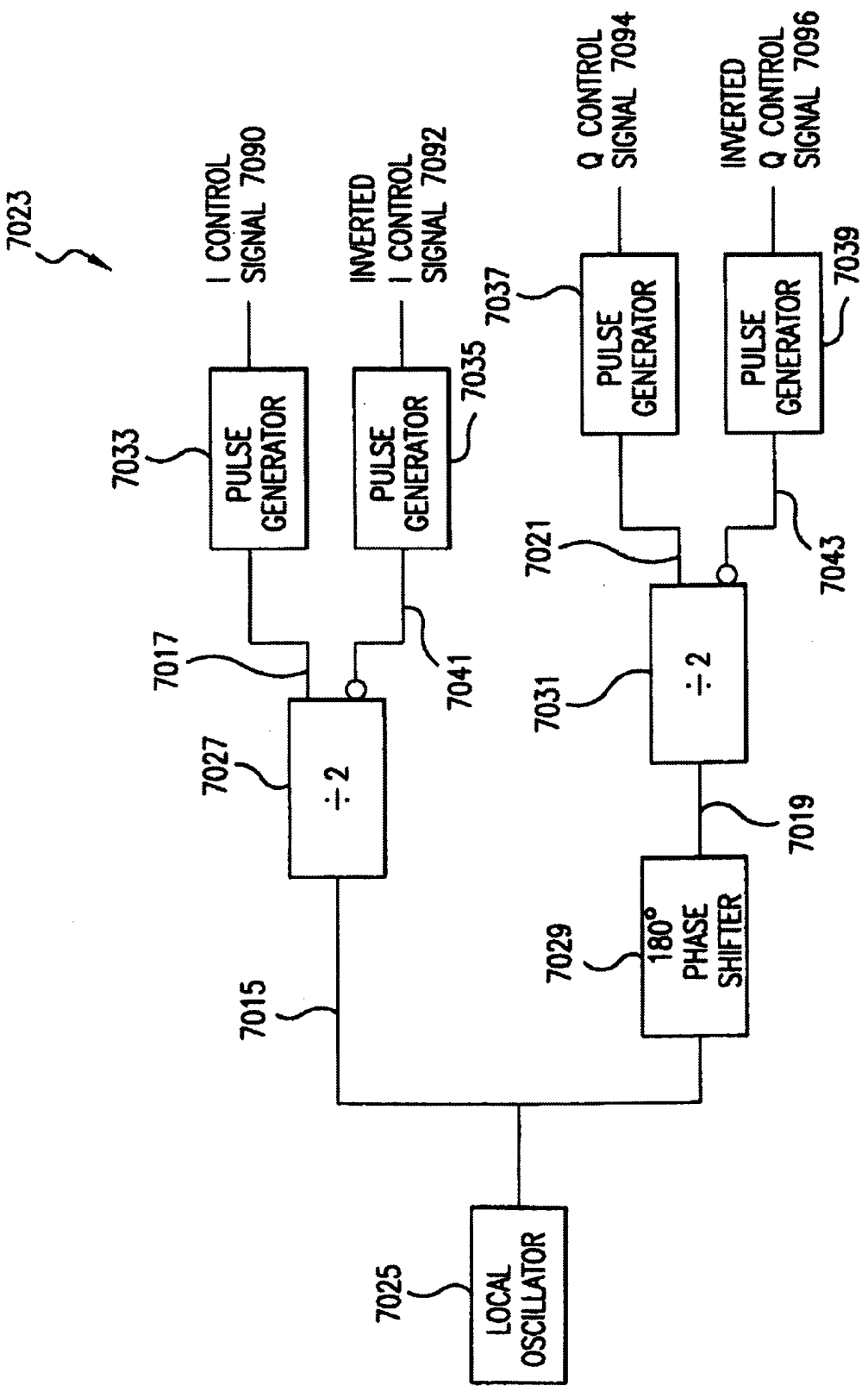

7023
I CONTROL SIGNAL 7090
INVERTED I CONTROL SIGNAL 7092
Q CONTROL SIGNAL 7094
INVERTED Q CONTROL SIGNAL 7096
7033
PULSE GENERATOR
7035
PULSE GENERATOR
7037
PULSE GENERATOR
7039
PULSE GENERATOR
7017
7041
7021
7043
7027
÷2
7031
÷2
7019
7029
180° PHASE SHIFTER
7015
7025
LOCAL OSCILLATOR

FIG.70B

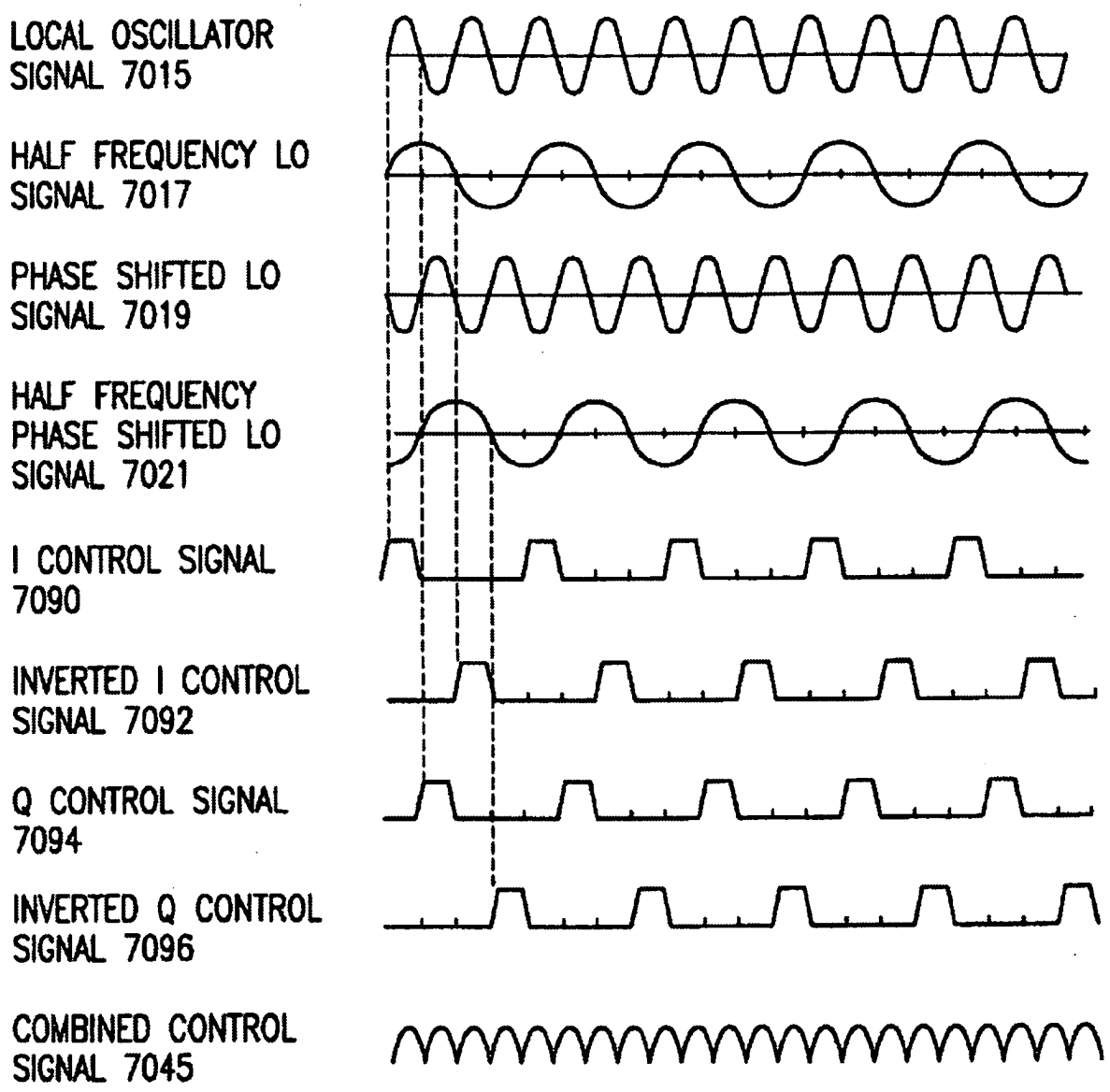

LOCAL OSCILLATOR SIGNAL 7015
HALF FREQUENCY LO SIGNAL 7017
PHASE SHIFTED LO SIGNAL 7019
HALF FREQUENCY PHASE SHIFTED LO SIGNAL 7021
I CONTROL SIGNAL 7090
INVERTED I CONTROL SIGNAL 7092
Q CONTROL SIGNAL 7094
INVERTED Q CONTROL SIGNAL 7096
COMBINED CONTROL SIGNAL 7045

FIG.70C

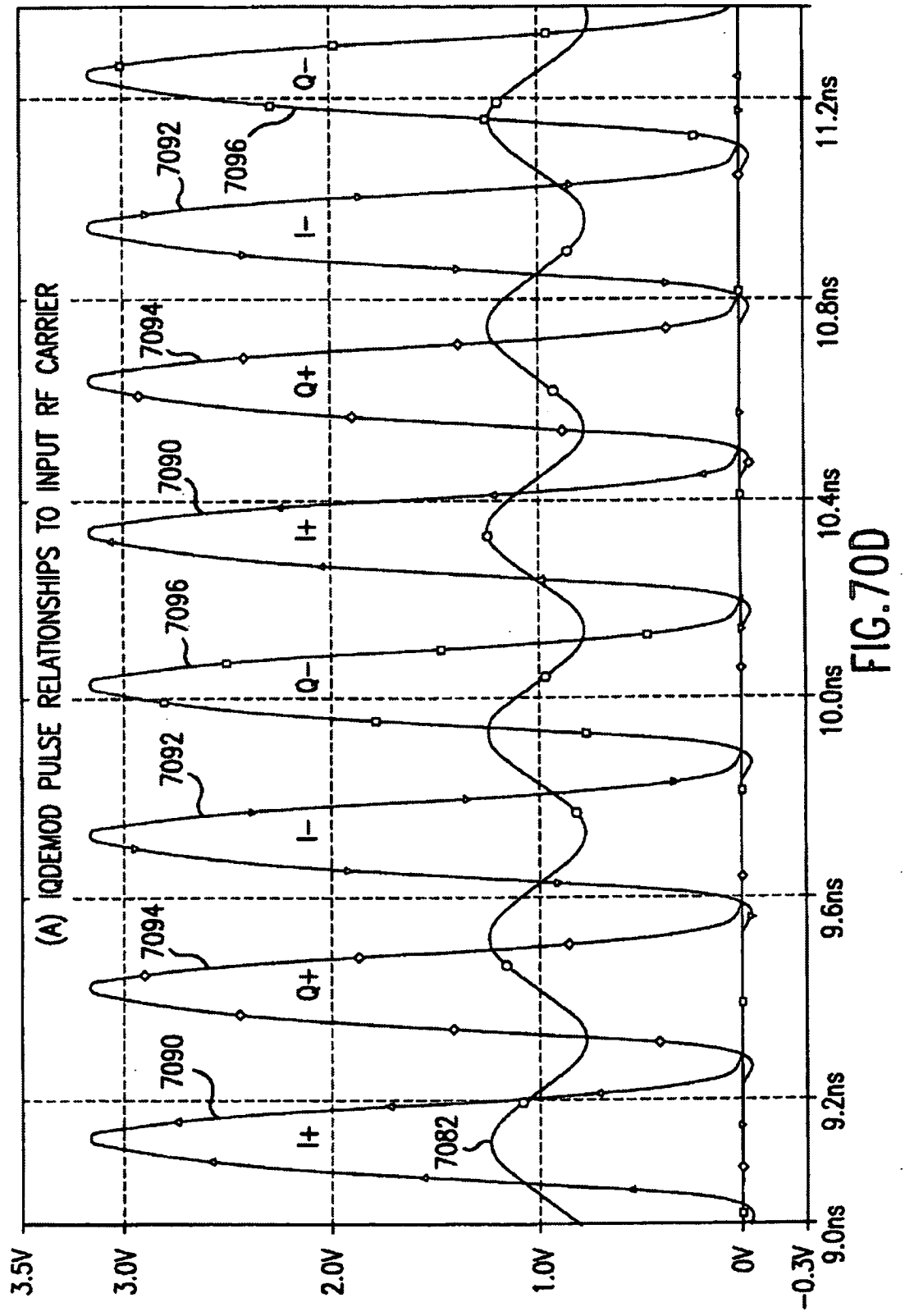

(A) IQDEMOD PULSE RELATIONSHIPS TO INPUT RF CARRIER
3.5V
3.0V
2.0V
1.0V
0V
-0.3V
9.0ns
9.2ns
9.6ns
10.0ns
10.4ns
10.8ns
11.2ns
7082
7090
7094
7092
7096
I+
Q+
I-
Q-

FIG. 70D

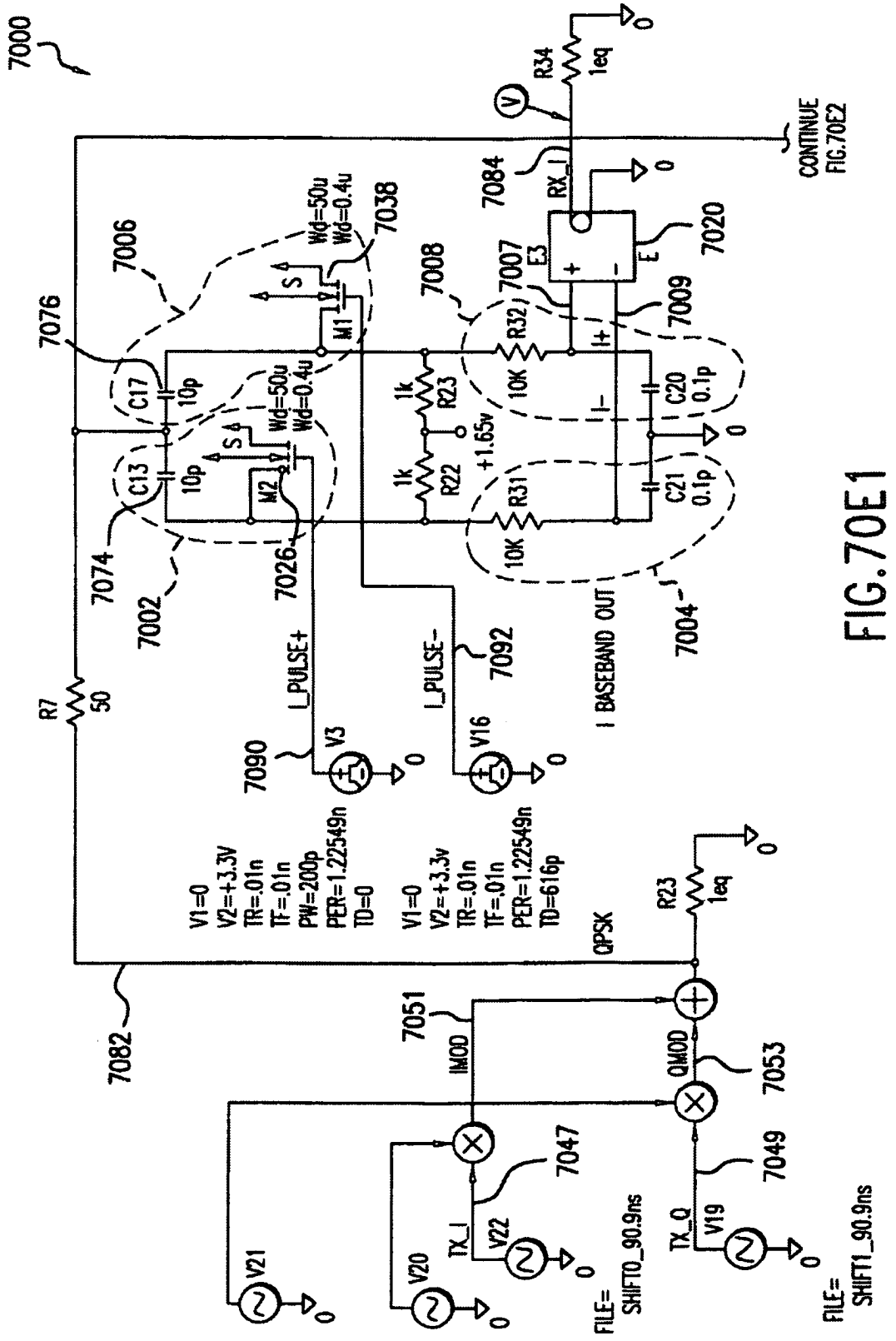

7000
R34
1eq
CONTINUE FIG.70E2
7084
RX_I
7020
7007
E3
7009
7038
Wd=50u
Wd=0.4u
7006
7008
7076
M1
R32
10K
C17
10p
1k
R23
C20
0.1p
+1.65v
C13
10p
M2
1k
R22
R31
10K
C21
0.1p
7074
7026
7002
7004
I BASEBAND OUT
R7
50
L_PULSE+
L_PULSE-
7092
7090
V3
V16
V1=0
V2=+3.3V
TR=.01n
TF=.01n
PW=200p
PER=1.22549n
TD=0
V1=0
V2=+3.3v
TR=.01n
TF=.01n
PER=1.22549n
TD=616p
QPSK
R23
1eq
7082
7051
IMOD
QMOD
7053
7047
7049
V21
V20
TX_I
V22
TX_Q
V19
FILE= SHIFT0_90.9ns
FILE= SHIFT1_90.9ns

FIG.70E1

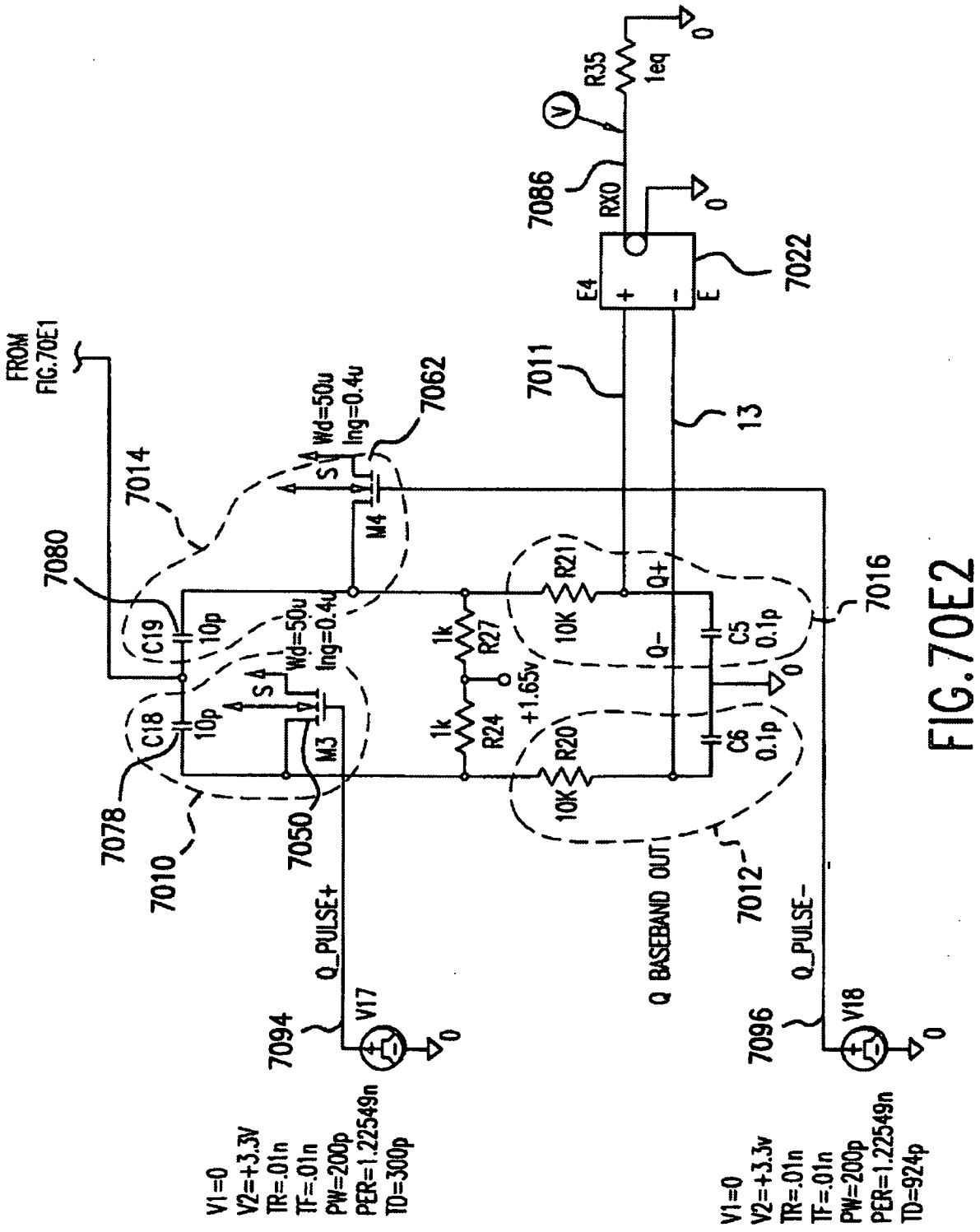

FROM FIG.70E1
7014
7080
7078
7010
7050
7062
Wd=50u
lng=0.4u
M4
M3
C19
C18
10p
10p
S
7011
13
7086
RX0
R35
1eq
E4
7022
R21
10K
R27
1k
R24
1k
R20
10K
+1.65v
Q+
Q-
C5
0.1p
C6
0.1p
7016
7012
Q BASEBAND OUT
Q_PULSE+
Q_PULSE-
7094
7096
V17
V18
V1=0
V2=+3.3V
TR=.01n
TF=.01n
PW=200p
PER=1.22549n
TD=300p
TD=924p

FIG.70E2

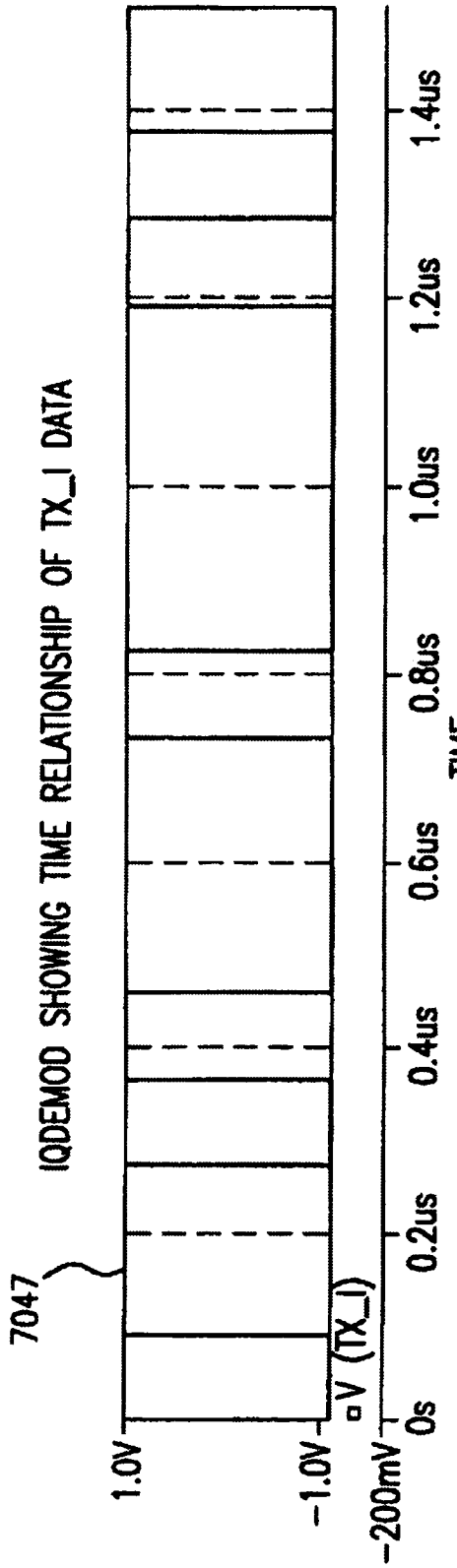


FIG.70F

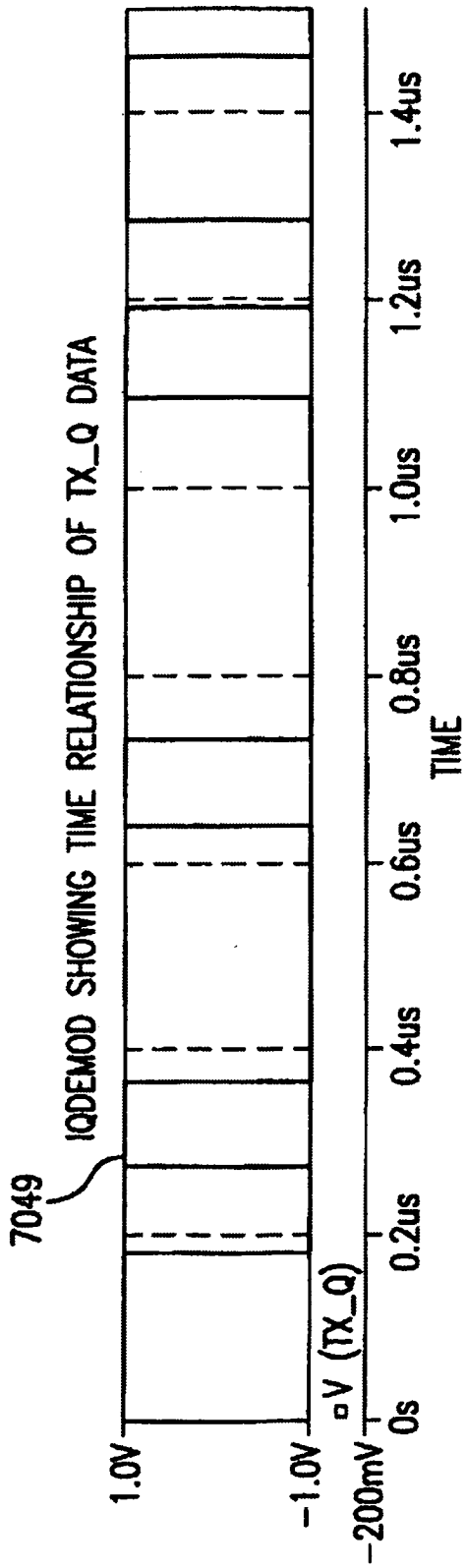


FIG.70G

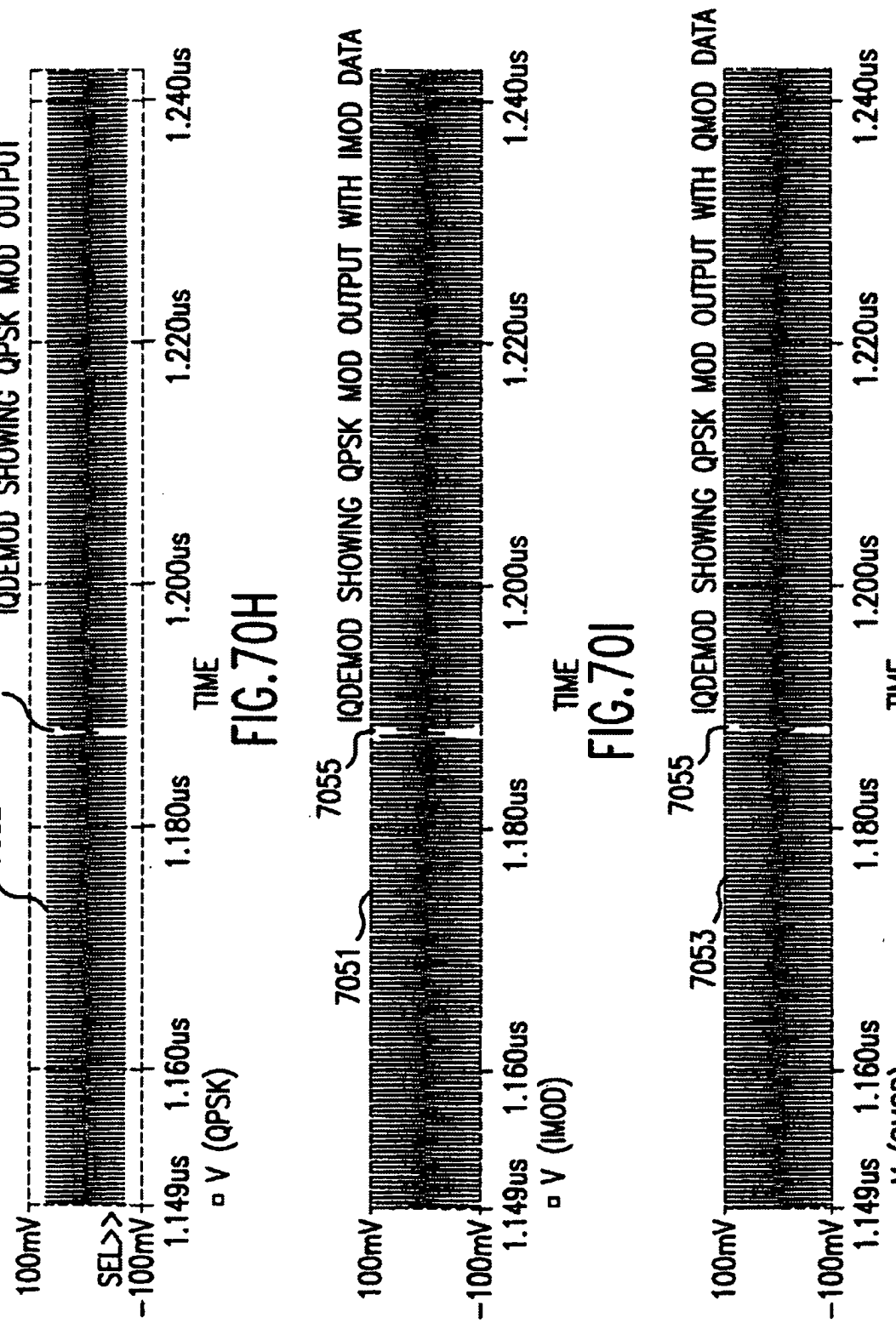


FIG.70H

FIG.70I

FIG.70J

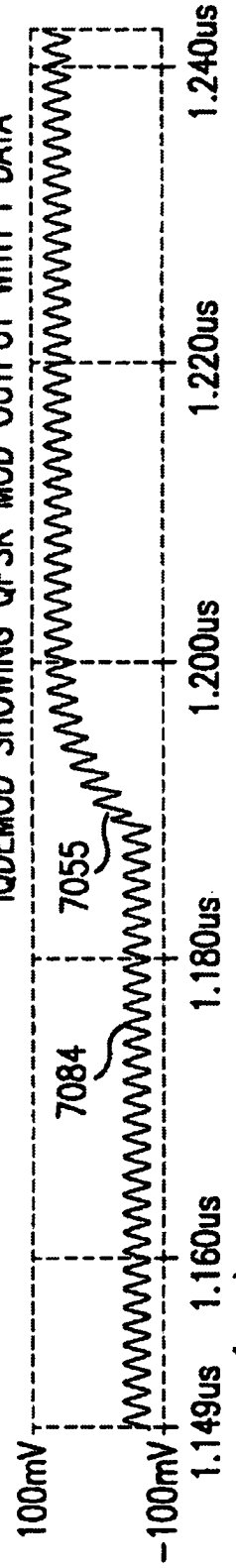


FIG.70K

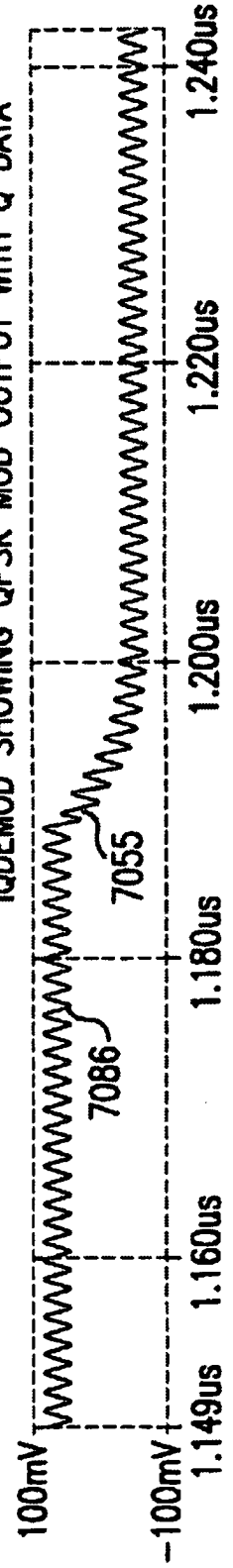


FIG.70L

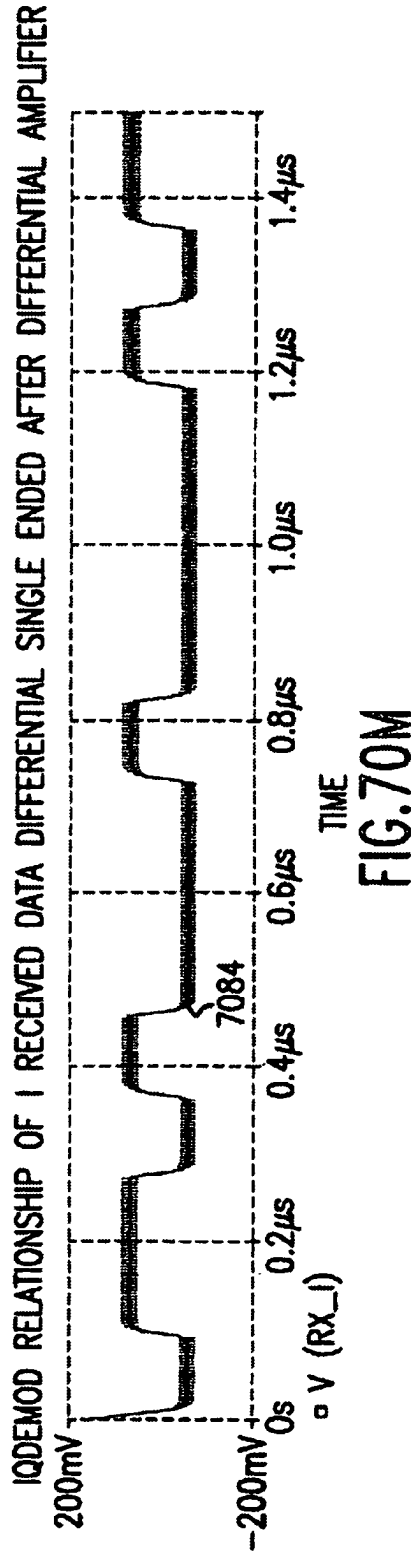


FIG.70M

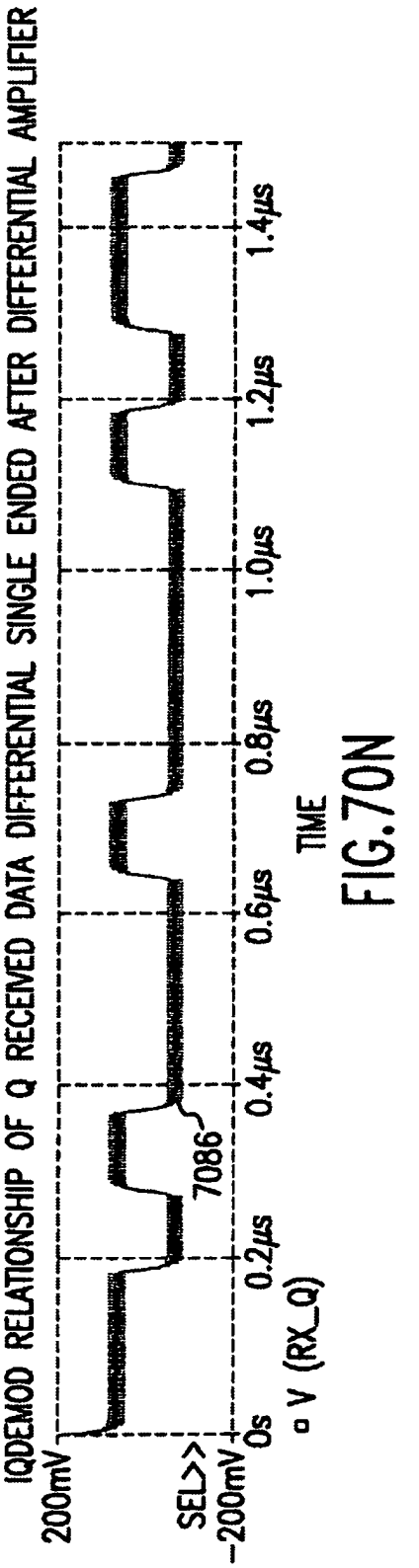


FIG.70N

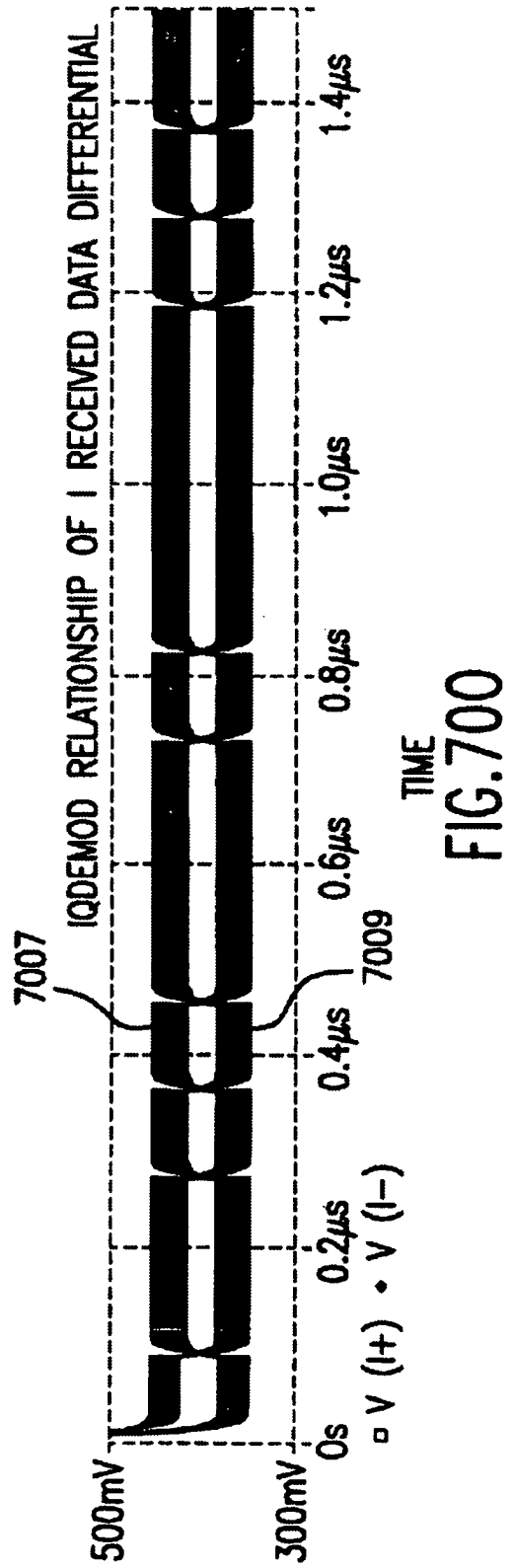


FIG.70O

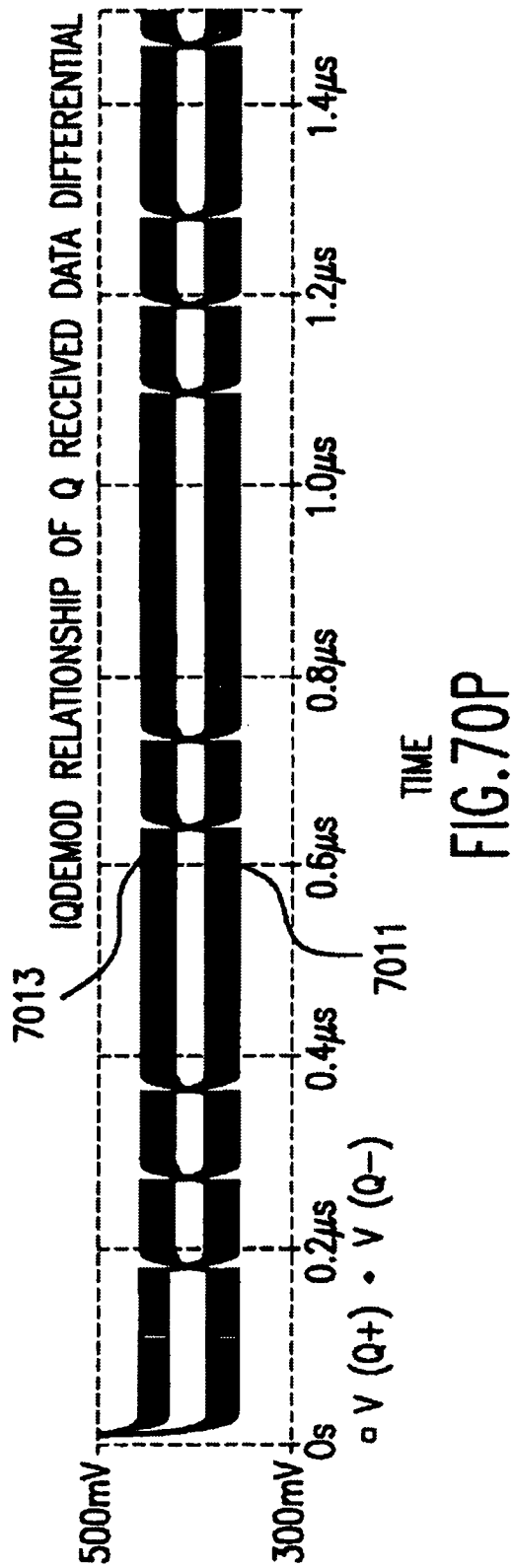


FIG.70P

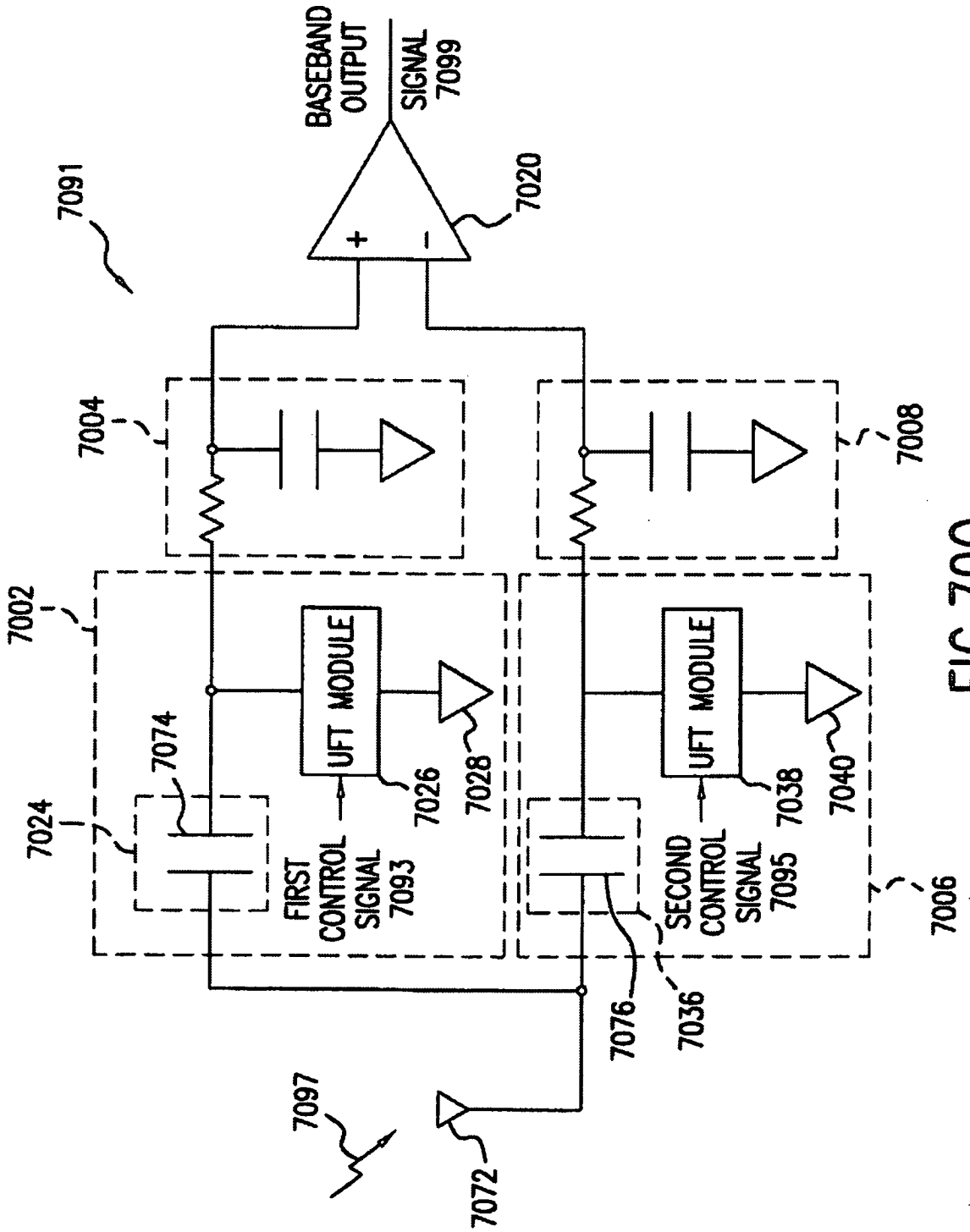

BASEBAND OUTPUT SIGNAL 7099
7091
7020
+
-
7004
7008
7002
UFT MODULE
UFT MODULE
7074
7024
7026
7028
7038
7040
FIRST CONTROL SIGNAL 7093
SECOND CONTROL SIGNAL 7095
7006
7076
7036
7097
7072

FIG. 70Q

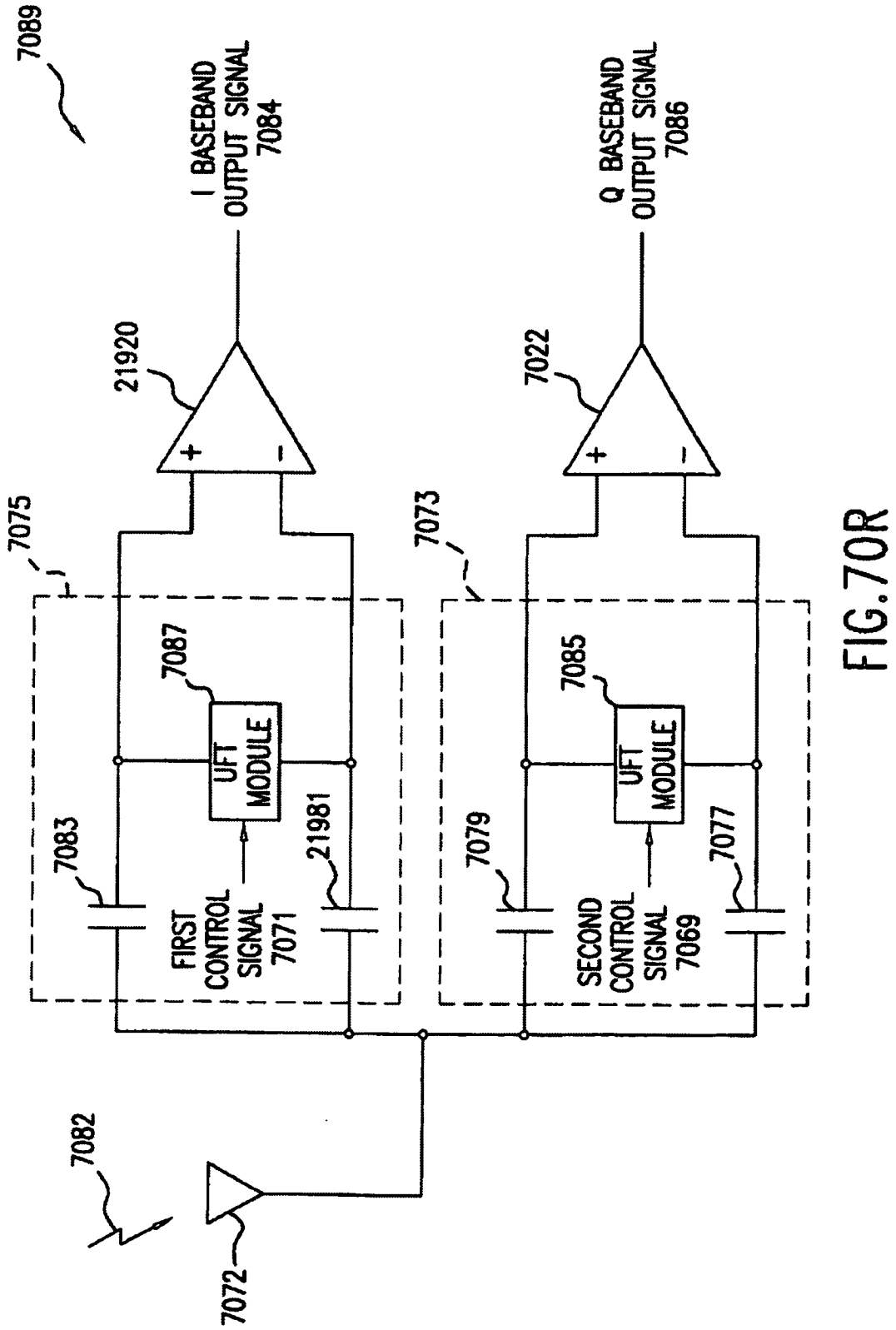

7089
I BASEBAND OUTPUT SIGNAL 7084
Q BASEBAND OUTPUT SIGNAL 7086
21920
7022
+
-
7075
7073
7087
7085
UFT MODULE
UFT MODULE
7083
21981
7079
7077
FIRST CONTROL SIGNAL 7071
SECOND CONTROL SIGNAL 7069
7082
7072

FIG.70R

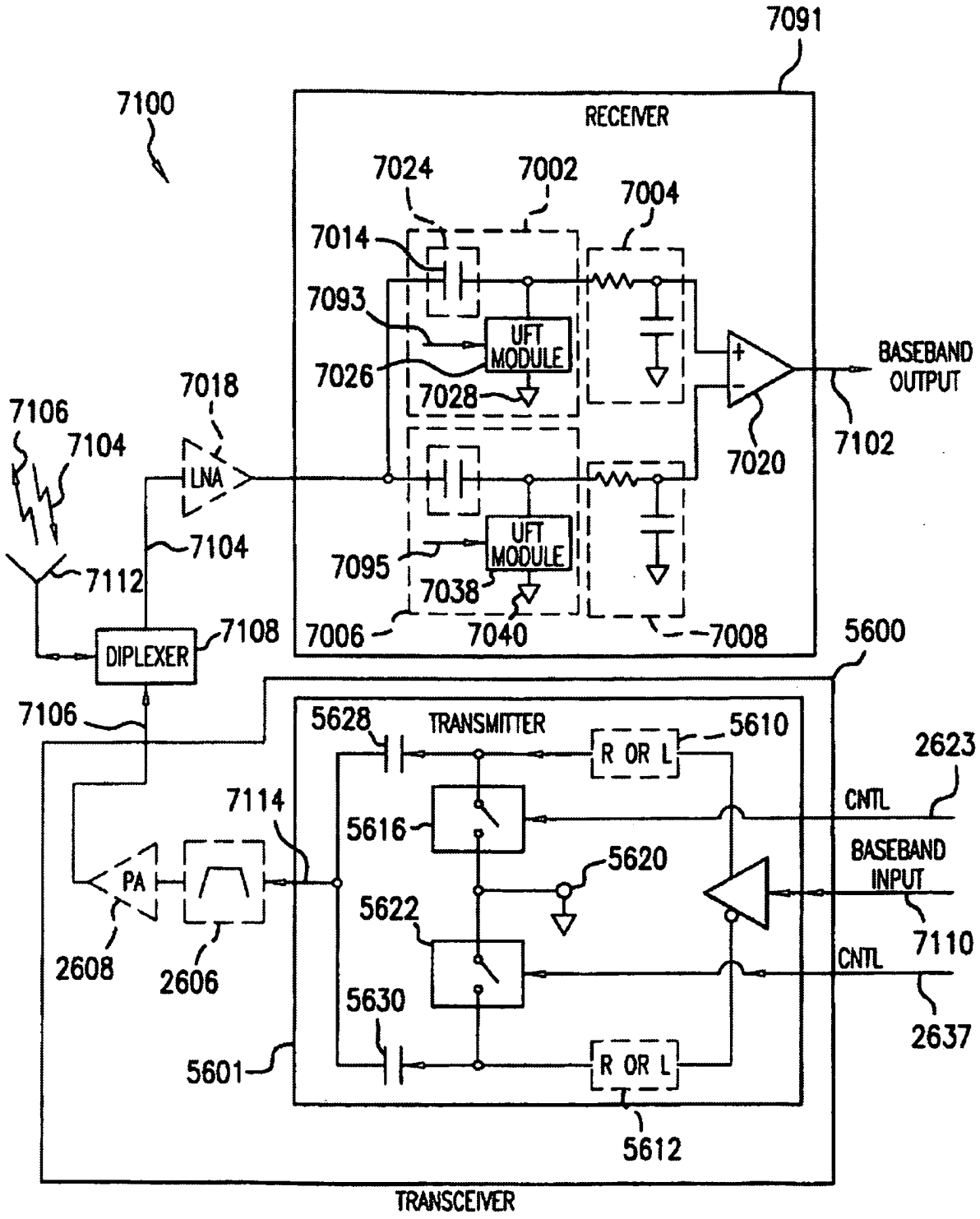

7091
7100
RECEIVER
7024
7002
7004
7014
7093
UFT MODULE
7026
7028
BASEBAND OUTPUT
7018
7106
7104
LNA
7020
7102
7104
7095
UFT MODULE
7112
7038
7108
DIPLEXER
7006
7040
7008
5600
7106
5628
TRANSMITTER
5610
R OR L
2623
CNTL
7114
5616
5620
BASEBAND INPUT
PA
5622
7110
2608
2606
CNTL
5630
2637
5601
R OR L
5612
TRANSCEIVER

FIG.71

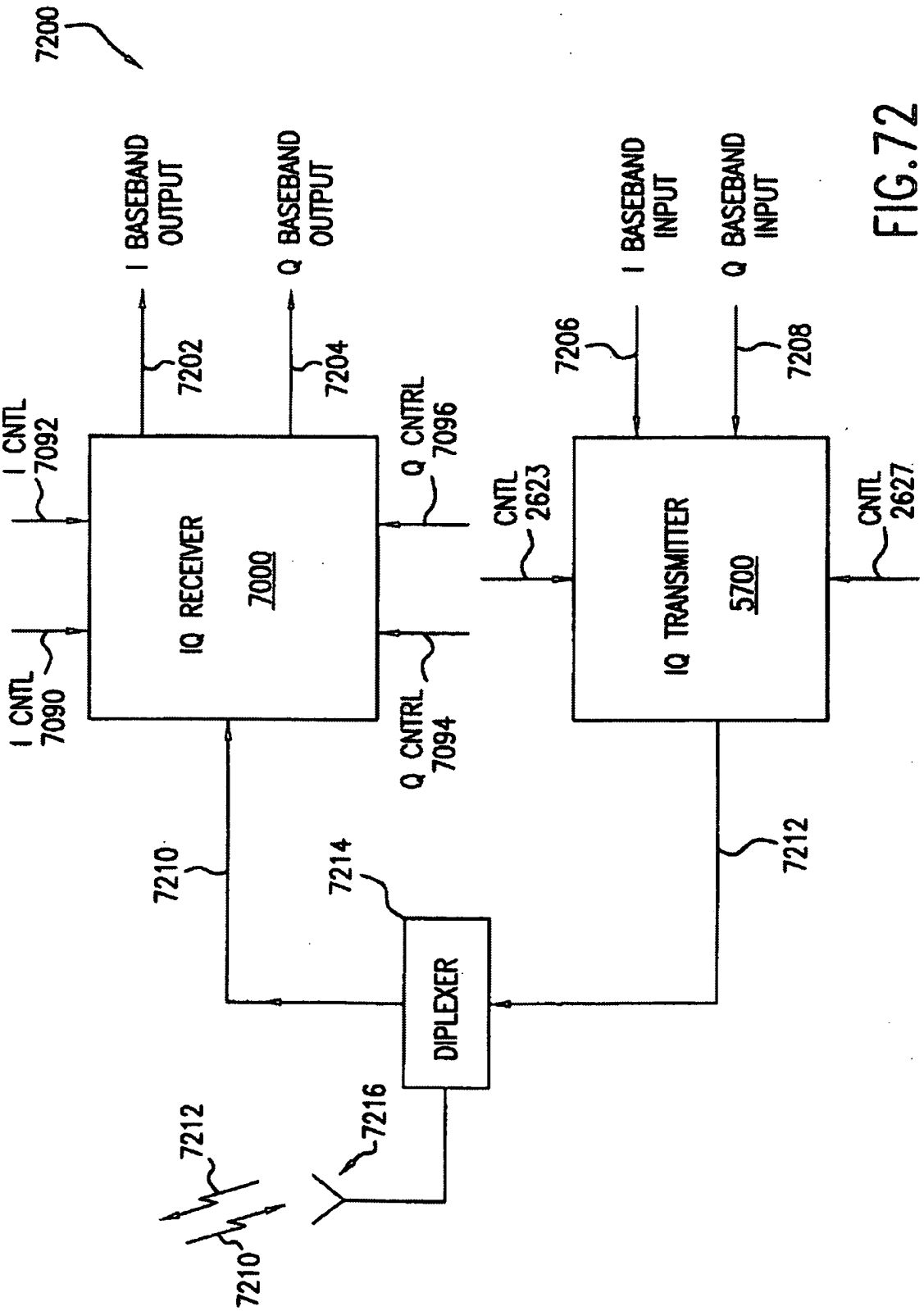

7200
I BASEBAND OUTPUT
Q BASEBAND OUTPUT
I BASEBAND INPUT
Q BASEBAND INPUT
7202
7204
7206
7208
I CNTL 7092
Q CNTRL 7096
CNTL 2623
CNTL 2627
IQ RECEIVER 7000
IQ TRANSMITTER 5700
I CNTL 7090
Q CNTRL 7094
7210
7214
7212
DIPLEXER
7216
7212
7210

FIG.72

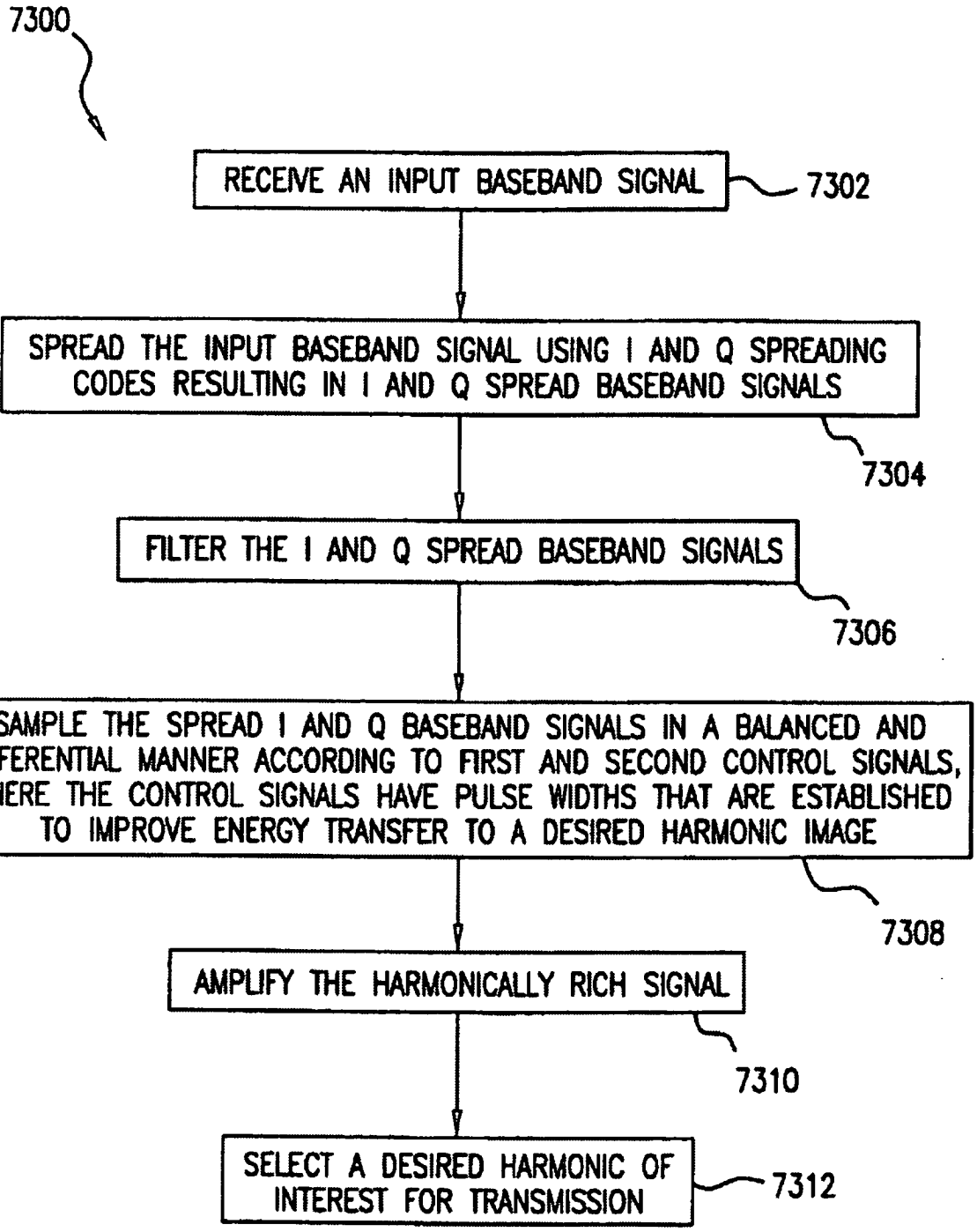

7300
RECEIVE AN INPUT BASEBAND SIGNAL
7302
SPREAD THE INPUT BASEBAND SIGNAL USING I AND Q SPREADING CODES RESULTING IN I AND Q SPREAD BASEBAND SIGNALS
7304
FILTER THE I AND Q SPREAD BASEBAND SIGNALS
7306
SAMPLE THE SPREAD I AND Q BASEBAND SIGNALS IN A BALANCED AND DIFFERENTIAL MANNER ACCORDING TO FIRST AND SECOND CONTROL SIGNALS, WHERE THE CONTROL SIGNALS HAVE PULSE WIDTHS THAT ARE ESTABLISHED TO IMPROVE ENERGY TRANSFER TO A DESIRED HARMONIC IMAGE
7308
AMPLIFY THE HARMONICALLY RICH SIGNAL
7310
SELECT A DESIRED HARMONIC OF INTEREST FOR TRANSMISSION
7312

FIG.73

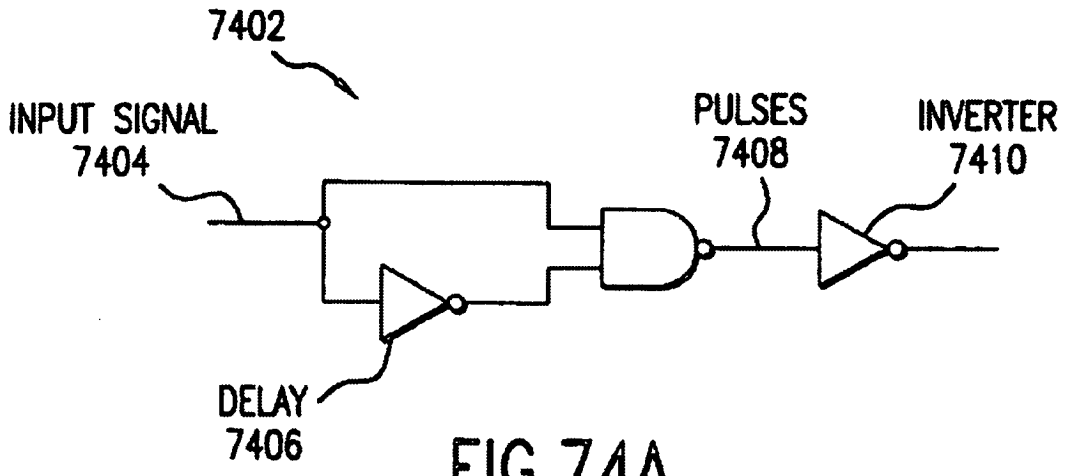


FIG.74A

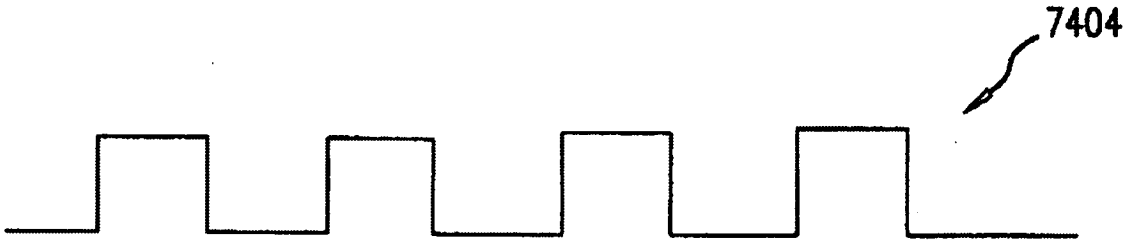


FIG.74B

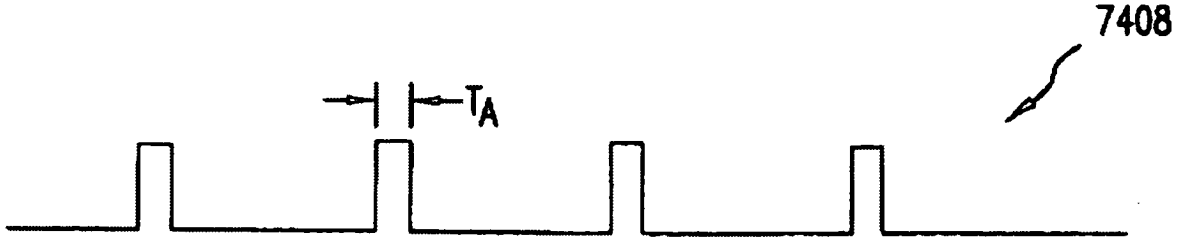
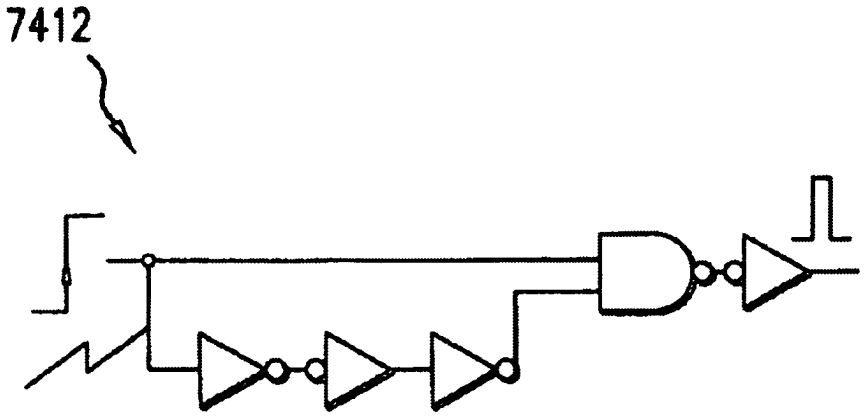
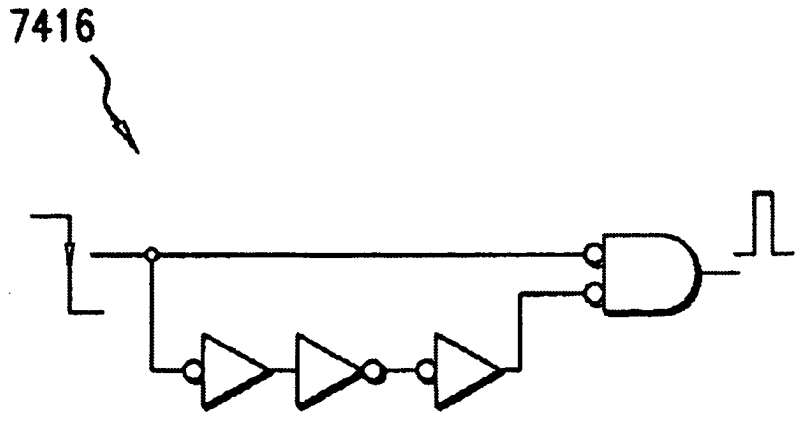


FIG.74C



RISING EDGE PULSE GENERATOR

FIG.74D



FALLING-EDGE PULSE GENERATOR

FIG.74E